THURSDAY, APRIL 18, 1901.

EGYPTIAN CHRONOLOGY.

A Self-verifying Chronological History of Ancient Egypt. A Book of Startling Discoveries. By Orlando P. Schmidt. Pp. 569. (Cincinnati: O. G. C. Shaw, 1900.)

THE portly volume before us professes to deal with the "chronological history" of Egypt, and to treat the subject in such a lucid manner that every part of it explains itself and "proves" itself. The author is candid, and advertises his work in the freest possible manner, and he appears to be thoroughly convinced of the supreme value of his labours. According to him, the field of Egyptian history was hastily explored, "usually at odd times"—whatever that may mean—but armed with his "key," which a "fortuitous discovery" had placed in his hands, he "entered a lost world, all recollection of which had died out, and there made a series of discoveries, and gathered together a great mass of new historical facts, the startling and far-reaching importance of which it would be almost impossible to estimate." He admits that he once held many of the opinions common to modern Egyptologists in general, but his "native common sense recoiled from" the errors and superstitions regarding the Egyptians which were current among so-called "scientists"; though of certain errors and superstitions he once found it impossible to free his mind, and apparently this is still the case. He wrote his book whilst "the researches were being made," and his "point of view was constantly changing," and his "horizon was constantly widening." Among Egyptologists, the author thinks "superficial skepticism" has taken the place of "scientific criticism," and this had led many of them "to belittle and misrepresent the civilisation of Egypt prior to the beginning of the Fourth Dynasty," and they tell us "flat footed" (whatever this word may mean here) "that the first three dynasties of Manetho were mythical." Mr. Schmidt thinks that the names of Noah, Shem, Ham and Japheth are Egyptian and not Hebrew words, and he says that "scientists" will have to account for the remarkable coincidence between the date of the Hyksos expulsion and that of Jacob's birth.

The merest glance at the book shows that Mr. Schmidt has built his book up entirely, in our opinion, from the works of Egyptologists, and yet he does not wish to "weaken the effect of the facts presented" by encumbering the text with a mass of miscellaneous citations from so-called "authorities," an ingenious way of avoiding the publication of his vast indebtedness. He is not content with setting Egyptian chronology on a firm base, but he wishes to take a prominent position as an exponent of the vexed Mycenæan question, for he tells us quite gravely that the "Ionians (*Ja-nim*) were settled in the Grecian Archipelago and on the adjoining shores of Greece and Asia Minor as far back as the reign of Teta, or 3146 B.C."! It has been necessary to select the above statements from Mr. Schmidt's preface so that the reader may know the manner and style of the book which he has to deal with; but before we attempt to summarise the general contents we must point out that the industrious author of this remarkable compilation seems to have been mistaken on certain important points. To begin with, all the evidence which has been derived from prehistoric sites in Egypt during the last six years proves conclusively that the first three dynasties are historical facts, and no competent Egyptologist ever doubted the existence of the kings who belonged to them. It is clear, from the remarks which Mr. Schmidt makes in his preface, that he does not know enough Egyptology to decide what authority to follow. Egyptologists have for a generation or more declared the great antiquity of Egyptian civilisation, and it is only the semi-religious and pseudo-scientific writers on Egyptian history who have been too biased to see the light; the writings of some of the latter must form the slain enemies whom Mr. Schmidt sets out to slay again. Had Mr. Schmidt read M. J. de Morgan's "Recherches Préhistoriques," which were published in 1896 and 1897, he would have seen that Egyptian civilisation must be thousands of years older than he supposes; and it is possible that he would have kept his work in manuscript. Sir Norman Lockyer has proclaimed, in his "Dawn of Astronomy," with no uncertain voice the great antiquity of Egyptian civilisation, and, what is more, his facts have never yet been controverted; but we see no mention of the results achieved by de Morgan and Lockyer, or even any indication that they are known to him in Mr. Schmidt's book. We have no wish to belittle the work of any pioneer in archæology, but when we see Mr. Schmidt solemnly quoting Canon Rawlinson's *old* publications on Egyptian chronology we feel sure that he does not know how to select his authorities; and if he refers to excellent and, according to their bias, honest men like Canon Rawlinson as "authorities," it proves conclusively that he does not know what an Egyptologist is.

Mr. Schmidt divides his book into two parts, which are preceded by a preface, from which we have already quoted, and by an introduction; in the first part, he deals with the Sothiac (*sic*) system of chronology and the lists of Manetho, the Twelve Months, the Signs of the Zodiac, the formation of the Solar System, the present state of Egyptian chronology, the Sothiac (*sic*) year, Manetho, the chronological numbers in Josephus, &c. In each of these sections he lays down the law in an arbitrary manner, and he incorporates in his paragraphs a number of remarks which appear to us as irrelevant. In the second part, he discusses one dynasty after the other, and accepts what suits his own views in the writings of ancient and modern authors, and rejects as worthless what he cannot explain in their works. We have read the book with some care, but have not yet found the "startling discoveries" which Mr. Schmidt professes to have made, and we have failed to see how his chronological history is "self-verifying." We are familiar with the Sothic year, and the manner in which it has been applied to the elucidation of Egyptian chronology; but as different investigators, though using the same data concerning the rising of Sothis, arrive at different results, we feel that its correct application is not in all cases sufficiently understood. No one doubts that the Egyptians were astronomers of no mean order, and in recent years Sir Norman Lockyer has shown us what an integral part of their religious system the knowledge required for orienting temples was; but more would be known of their astronomical knowledge if the astronomical texts could be fully

understood in these days, and it is impossible to assign correct meanings to them until we know the exact signification of every word which occurs in them.

The weak part of Mr. Schmidt's argument is that, even supposing all his statements about dates in the Sothic year were correct and could be proved, he does not allow a sufficient number of Sothic years to cover the long period of years in which the Egyptian civilisation was evolved, and developed, and matured, and decayed; and it seems to us absurd to limit this period to three Sothic years, or 4380 ordinary years. Mr. Schmidt's system of chronology is worth no more than any other in which a large amount of "playing at doing sums" occurs, and he has merely put together in book form a series of notes and extracts from the works of Egyptologists, and from those of writers like Bunsen and Cory, which he has arranged according to his own peculiar views; the result is a perfectly unreadable volume of 569 pages, in which the "omissions" of one ancient authority and the "mistakes" of another are paraded in a bewildering manner. We have no wish to be flippant or to treat Mr. Schmidt's book in other than a serious manner, but his conclusions remind us forcibly of the result of the investigations into the date of the building of the Tower of Babel of the eminent English divine who declared that the "last brick was laid on the top stage of the Tower of Babel at Borsippa at 4 p.m. on Thursday, April 15, B.C. 2247." We cannot possess a continuous and accurate chronology of Egypt until we know how many kings reigned between Mena and Nectanebus, and how many years each reigned, and who succeeded whom; to make such a chronology at present is impossible because the necessary data do not exist. The writer who assigns precise dates to certain events in Egyptian history, *e.g.* the date B.C. 4244 to "the establishment of the kingdom," probably deserves to be considered either a "crank" or a charlatan, and in any case the presumption of the writer who asserts definitely that the Ionians were settled on the shores of "Greece and Asia Minor as far back as the reign of Teta, or 3146 B.C." is stupendous.

We are not reassured on the matter of Mr. Schmidt's scholarship when we find such blunders and spellings as the following: Puon-et, p. 7, *uae* (there is no such word) p. 9, Hyk-sat-u, p. 13, Rokchoris, p. 14, Tarako, p. 14, Sothiac, p. 16 and *passim*, Sopdet, p. 17, Uon-nofer, p. 20, Ânu, p. 27, Ach-i-u, Ta-ān-nut, p. 30, Pa-api, p. 35, Amen-em-het, p. 49, Rohk-nez, p. 52, Num, p. 61, Usertasen, p. 81, Quebahu, p. 105, the identification of Ta-ânut (*sic*) with This, the derivation of the Hebrew name "Adam" from that of Mena, the first historical king of Egypt (!), p. 117, Hus-et and Hus-ir, p. 122, Per-son, p. 131, Osiropis, p. 253, Zawyet-el-Arrian, p. 268, Elephantinæn, *ibid.*; this list might be increased almost indefinitely. Mr. Schmidt looks upon the story of the Flood as an allegory which he interprets thus. Noah was born B.C. 2948, and the Flood "broke loose" over the land B.C. 2348; Thebes became independent B.C. 2948, and the XIth, XIIth and XIIIth dynasties of kings reigned exactly 600 years, *i.e.* a period equal to the age of Noah when the Flood "broke loose." According to Mr. Schmidt the Flood was no flood of water, but an invasion of Hyksos, and the ark to which Noah and his family, &c., fled was nothing else than the city of Thebes, because the Hebrew word for ark is *Têbhâh*, and this, according to Mr. Schmidt, is the name of the city called Thebes. The sending forth of the dove from the ark is another part of the allegory, and means that Noah and his sons sent forth from Thebes messengers to the Hyksos offering their submission, which was duly accepted, and payment of tribute imposed upon them!

From reasoning of this kind the reader will easily be able to gauge Mr. Schmidt's qualifications as a reformer of the chronology of Egypt; as a final proof of the correctness of his views on this subject he points triumphantly to the fact that the fifteen cubits of height above the mountains which the waters reached at the time of the Flood refers to the depth of the waters of the annual Nile inundation, which he declares to be exactly fifteen cubits at Heliopolis! When he deals with Babylonian questions Mr. Schmidt is equally unfortunate, for on p. 545 he gravely refers to the discovery of a tablet "recording the war waged by Khammurabi against Eri-aku and his Elamite allies"; a reformer of Mr. Schmidt's pretensions should at least have shown that he had read that this "discovery" was exploded finally by Mr. L. W. King in the first volume of his "Letters of Khammurabi," published in 1898, for, as now stated by Mr. Schmidt, his arguments fall to the ground. Before he writes another book of "startling discoveries" we hope he will read the current literature of the subject, and will remember that assertion is not evidence, and that theories and hypotheses are not proofs.

ELECTRO-CHEMISTRY.

Practical Electro-Chemistry. By G. Bertram Blount. Pp. xi+374. (Westminster: A. Constable and Co., Ltd., 1901.) Price 15*s.* net.

ALTHOUGH the foundation on which electro-chemistry is built was to a large extent laid by the genius and splendid research work of two Englishmen, Davy and Faraday, and is practically based on the laws enunciated by the latter, yet to-day, when many branches of industrial chemistry are being revolutionised by the introduction of this branch of chemical science, we as a nation know practically nothing about it. In America we are confronted by numerous works upon the subject; if we turn to Germany, there again we find a whole library of books devoted entirely to electro-chemical science and to its industrial application. Turning to our own country, what do we see? One or two books on electro-plating, books on electrical engineering, and a few *translations* of German works on electro-chemical analysis.

It was, therefore, with sincere pleasure and eager anticipation that one saw, in the publishers' announcements at the end of last year, that Messrs. Constable and Co. would shortly bring out a work on "Practical Electro-Chemistry," by Mr. Bertram Blount. The book which is now published consists of eight sections devoted to different branches of electro-chemistry.

The first, or introductory, section treats in an interesting manner of electrolysis and more or less of the theory of solution. A useful subsection is also given on the "Method of calculating output in electrolytic processes." After discussing at no very great length a particular

case, viz. that of the electrolysis of fused sodium chloride, Mr. Blount says:

"Thus in practice he who is firmly grounded in these primary principles can deal with each particular case as it arises, not experimenting blindly, but with certain definite and exact generalisations to guide him."

This is very true, but the example taken is one in which the course of reaction is very readily followed out, and although we presume Mr. Blount does not profess to deal exhaustively with this phase of the subject, yet the section would have been much more instructive if Mr. Blount had also included an example where the main reactions are masked by secondary changes.

The next section deals with "Winning and refining of metals by electrolytic means in aqueous solutions." To the winning and refining of copper as being "the largest of all electrolytic industries" is assigned the chief place. The author has failed to treat this part of the subject with sufficient breadth. There are two main methods for obtaining copper electrolytically—the multiple system, in which the anodes and kathodes are suspended opposite to each other, and the series or Hayden system, in which at one end of the vat there is an anode plate, at the other end a kathode plate, the intervening space being occupied with plates of the same quality as the anode plate. These plates function both as anode and kathode, the surface opposite the anode acting as kathode, that opposite the kathode as anode. Mr. Blount has dealt fairly fully with the multiple system, but only very shortly with the Hayden system, which he condemns, hardly, however, giving sufficient evidence for his condemnation. Surely, also, a little more space might profitably have been devoted to the treatment of the anode sludge, the successful working up of which often goes a long way towards making an electrolytic process a paying one.

On p. 125, with reference to the difficulties met with in obtaining nickel in a state of purity, the author gives this useful warning:

"The study of the degree of purification effected by the electrolytic refining of nickel is particularly instructive, and should suffice to dispose of, once for all, the ridiculous belief that a metal prepared by electrolysis is necessarily and *ipso facto* of unusual purity."

The author is hardly correct in saying that no serious attempt appears to have been made to refine tin electrolytically. He is evidently unaware that a patent has been taken out by Mr. Claus for refining impure tin. In Mr. Claus's process, tin cast into plates is made the anode in a bath of sodium sulphide, the kathode being of tinned iron. The impurities, as well as gold and silver, remain in the anode sludge, and tin is deposited in a very high state of purity at the kathode.

Probably the third section, which treats of the electrolysis of fused salts, will be of most interest to the general reader, seeing that under this head the production of aluminium is naturally dealt with. The short section on the electric furnace, carbides and the researches of Moissan, which follows, will repay perusal, if only by pointing out the vast fields of research which the introduction of electricity to chemical processes has opened up.

Section vi., which is assigned to alkali, chlorine and their products, is extremely disappointing. This branch is, perhaps, one of the most important in the whole range of electro-chemistry, and should therefore have been treated comprehensively. The production of chlorine and caustic soda by electrolysis of common salt receives somewhat exhaustive treatment. But the important, much-worked-at and widely-debated subject of hypochlorites and chlorates, together with the practical and theoretical causes which underlie these processes, are handled most inadequately. The casual reader would carry away the impression that if a cold solution of a chloride is electrolysed without a diaphragm, a solution of a hypochlorite will be produced, but that on electrolysing at high temperatures a chlorate will be obtained. Unfortunately, the electrolysis of a chloride is by no means so simple. There is a very large amount of literature on the subject, and if Mr. Blount had endeavoured to summarise the various methods and the theories advanced, this section would have been very valuable, but he has unfortunately failed to do this.

The part devoted to electrolysis of organic compounds is short, and therefore it would be rash to expect too much from it.

The book as a whole is eminently readable, but it is doubtful whether it will be of much value to the manufacturer or practical chemist. But, in fairness to the author, let us not forget that it is extremely difficult to obtain trustworthy and authentic information of manufacturing processes; the main facts may be published, but it is often the seemingly unimportant details which make or mar a process. The value of the work to the scientific reader would have been greatly enhanced if the author had given references to the original literature from which he obtained his information. To general chemical students the book, although not entirely up to date, may be recommended, in that it deals with the newest of chemical industries in an interesting manner, and will perhaps induce some of the younger chemists to engage in this important branch of study.

F. MOLLWO PERKIN.

SCLATER'S MAMMALS OF SOUTH AFRICA.

The Mammals of South Africa. By W. L. Sclater. Vol. ii. Pp. xii+241. Illustrated. (London: Porter, 1901.)

THE first volume of this important work having been already reviewed in these columns, and its main scope and style referred to, our notice of the second and concluding volume may be comparatively brief, especially as it is chiefly devoted to the smaller mammals, such as rodents, bats and insectivora, which command a much smaller sphere of general interest than is the case with their larger terrestrial relatives.

In describing the rodents and bats, the author has been confronted with a task of considerable difficulty on account of having access to the types of many species only during short and busy visits to England. Consequently a considerable portion of this section of the work partakes in some degree of the nature of a compilation; and Mr. Sclater himself would probably be among the first to admit that some amount of revision will have to take place in the future with regard

to certain species and genera. When, however, these great difficulties are taken into account, it must be allowed that the author has fulfilled his task in a highly creditable and satisfactory manner.

And as regards nomenclature, classification and the splitting-up of certain old, unwieldy generic groups like the squirrels into divisions of smaller size, Mr. Sclater is well abreast of modern ideas. One of the most noticeable of these modern changes in classification is the transference of the so-called Cape jumping-hare—the spring-haas of the Boers, from its old association with the jerboas—to a position near the cane-rat and the porcupines. Nor is this all that is noteworthy in Mr. Sclater's remarks on the creature; for we are told that, in spite of the huge bounds it takes, "it is never very rapid in its movements, and can be easily overtaken." This information we have not found given in any of the other works to which we have turned. It is a matter for regret that the portrait of the spring-haas, like many of the other figures in the book, has not been executed in a more satisfactory style.

An old error—to wit, that it burrows—in connection with the cane-rat is also corrected, mainly on the evidence of the late Prof. Peters and Captain Drummond.

Among the most curious and interesting of all the smaller mammals of South Africa are the elephant-shrews, or jumping shrews, and the golden moles, and of each of these Mr. Sclater gives an excellent account, both as regards bodily characteristics and habits, although further observations are stated to be required with regard to the mode of life of the last-mentioned animal.

"The golden mole," writes the author, "is exceedingly common in gardens, where it makes runs in all directions in search of the worms and grubs on which it lives. Although generally supposed to be destructive, it is really a great aid to the gardener, as it destroys quantities of larvæ, especially those of a certain gamma moth. . . . A certain amount of mischief, however, is done by the mole in pursuit of its prey by disturbance of roots and freshly-sewn seeds."

In addition to the Rodentia, Chiroptera and Insectivora, the present volume also includes the South African Cetacea and Edentata. Among the cetaceans special interest attaches to the author's description of a specimen of the lesser sperm-whale recently taken in Table Bay, as the external characters of this rare whale have been hitherto very imperfectly known. Of the specimen in question Mr. Sclater gives a sketch, which shows the characteristic shark-like mouth and small dorsal fin. Certain differences in size which have been thought to indicate specific distinction are, in the author's opinion, probably due to difference of sex in the individuals which have from time to time been examined.

The aard-vark and the pangolin Mr. Sclater, although with some hesitation, still retains in the same order with the typical South American Edentata. And it must be confessed that certain observations which have recently been made with regard to the myology of these creatures tends, so far as it goes, to justify this conservatism. Whether there really is any close relationship between the two groups is a question of the very highest importance in regard to certain views that have been recently expressed in favour of a former connection between Africa and South America. And it would greatly help matters if a decisive answer could be given on this point.

Mr. Sclater may be congratulated on the completion of a very important and valuable work. R. L.

INFINITESIMAL GEOMETRY.

Einführung in die Theorie der Curven in der Ebene und im Raume. By Dr. Georg Scheffers. Pp. viii + 360. (Leipzig: Veit and Co., 1901.) M. 10.

THIS volume is the first of two which will make a complete work under the title "Anwendung der Differential- und Integral-Rechnung auf Geometrie." The subject-matter of the two volumes may be said to be, roughly, the infinitesimal geometry of curves and surfaces respectively. The first volume is divided into three sections, dealing with plane curves, curves in space, and developable surfaces. The first section does not attempt to be a complete exposition of the subject, and must be regarded as an introduction to what follows, intended to accustom readers who are already well grounded in differential and integral calculus to the style and methods which are employed later. The theory of the curvature of plane curves is based on the definition of contact of an assigned order, which is explained with great exactness. The differential invariants of a curve for the group of movements in the plane are fully investigated, and their properties established in an elementary manner without introducing notions of groups or partial differential equations. Envelopes, evolutes, singular points, and the geometrical significance of differential equations of the first order and degree are discussed shortly. In connection with the trajectories of a family of curves, the problem is completely solved of finding all curves for which the product of the normal and radius of curvature is constant. The remainder of the first section is devoted to an explanation of curvilinear coordinates.

The second section contains a thorough and systematic account of the curvature, torsion, and allied theory of curves in space. The dual interpretation of an orthogonal substitution of coordinates as a change of frame of reference and as a movement in space is first carefully explained, and the theory of the intrinsic properties of curves is built upon it. Particularly interesting are the discussions of the differential invariants and of the integration of the intrinsic equations of a curve, in the course of which an elementary account of Riccati's equation is given. Conditions for contact of an assigned order are carefully laid down, and from them the relations between a curve and its osculating circle and helices are deduced; in particular we have the interesting result that the axes of all osculating helices at any point generate a cylindroid.

In the third section the main properties of the surface generated by the tangents to a curve are established. The general ruled surface is introduced in order to provide a rigorous investigation of what is meant by saying that consecutive generators intersect. The remainder of the section is occupied with various loci connected with a given curve, such as evolutes, involutes, parallel curves, polar surface, rectifying surface, etc. The text ends with a short account of minimal lines and minimal curves.

Few points in this book call for adverse criticism. In determining the motion of the frame consisting of tangent, normal and binormal at any point of a curve, it would be clearer to introduce the curvature and torsion into the general formulæ for moving axes as measures of small rotations, and it would be more convenient to make a positive torsion correspond to a positive rotation (in this connection the English reader may be warned that the term "rechts-gewunden" is applied to what we should call a "left-handed" screw). It is surprising that no general method is given for expanding the coordinates in powers of the arc; the employment of these expansions very much simplifies the investigation of osculating helices and of the osculating cone, and can hardly be objected to on the ground of being a "Kunstgriff."

The book is written in a very pleasing style, with that light and clear touch which we are accustomed to associate with French writers, and except in one or two instances the analysis is very judiciously handled. For soundness it leaves nothing to be desired and its incompleteness is only an incentive to deeper research into the subject. Specially commendable are the careful explanations of points which are usually slurred over. A distinct feature is the introduction of imaginary quantities at an early stage and the discussion of exceptional cases that arise in connection with minimal lines and curves. The whole book is pervaded by the ideas which are associated with the name of the author's great master, Sophus Lie.

The type is clear and good, misprints seldom occur, and the figures are excellent. The practice of giving two or three orthogonal projections instead of one figure in perspective is much to be commended as a means of conveying exact information and of training the student to build up a mental conception of a figure in three dimensions.

The second volume, which is promised in the course of next year, will be awaited with the greatest interest.

R. W. H. T. H.

OUR BOOK SHELF.

Les Phénomènes électriques et leurs Applications. By H. Vivarez. Pp. vi + 574. (Paris: Carré and Naud, 1901.) Price Fr. 15.

M. VIVAREZ'S book covers almost the whole field of modern electrical practice in a manner which is neither too technical nor too popular. The daily increasing applications of electricity in the industries and arts render such a book valuable in two ways. In the first place, it should appeal to the ordinary engineer, manufacturer or man of science who finds himself obliged to make use of electricity in some way or other, and who can turn to its pages for general information on the subject. Secondly, the electrical engineer is generally obliged nowadays to become a specialist in some particular branch of his profession, and is liable, in consequence, to get out of touch with other branches with which it is desirable he should have a general, if not a detailed, acquaintance. Such he can obtain from a book of this kind. M. Vivarez has set out with the object of supplying the wants of these persons, and also, doubtless, the want of the intelligent amateur who is anxious to keep pace with modern industrial progress, and he has, we think, succeeded admirably in his endeavour. He has produced a book which is thoroughly readable and interesting, and is not at all overladen with calculation or technical detail. Perhaps in some cases he has shown rather a tendency to skip over the less interesting parts at a sacrifice of clearness, as, for example, in the section on units. This may not be of much importance to the electrician who will have obtained his fundamental conceptions elsewhere, but it is a great disadvantage to the non-electrical reader, who can never properly understand the subject unless his knowledge of the groundwork be sound—a truth he is himself too prone to ignore.

In a book of this kind a great deal depends on the proper proportioning of the space allotted to the various subjects considered. On the whole, M. Vivarez has divided his space very fairly, though he has given rather an undue preponderance to the more modern "engineering" developments. More space should, we think, have been devoted to telegraphy, which is at once the oldest and the most important application of electricity; electrochemistry and metallurgy are also treated somewhat too briefly. We looked in vain, also, for any description of vacuum tubes; their omission is unfortunate, seeing of what value they have become to mankind since Röntgen's discovery. The X-ray may have passed rather from the hands of the electrician to those of the surgeon, but it remains, all the same, an important "phénomène électrique."

The most interesting portions of the book, to our mind, are the historical parts. M. Vivarez has given a brief historical account of all the important developments, and has carried this to the extent of even giving a short history of the industrial employment of coal. These historical summaries are both interesting and valuable, the more so as this is a side of science too frequently neglected. Is it because the development is so rapid that the history cannot keep pace with it, or, as we are inclined to believe, because of the natural antipathy of the average engineer to anything that tends to be literary? In any case, there can be no doubt that many engineers will be found ignorant, not only of the works, but even of the names of the men who have made their profession, and for this reason we would recommend the book before us to the student of electrical engineering; it will show him the importance of the work of the man of science, and may bear useful fruit in inducing him to read original papers.

The Agricultural Changes and Laying Down Land to Grass. By R. H. Elliott, 2nd edition. Pp. xii + 101. (Kelso: J. and J. H. Rutherford, 1901.)

MR. ELLIOTT has for some years been pursuing a system of agriculture on his estate in Roxburgh, the essential feature of which is that he secures a thick turf by the use of heavy seedlings of the stronger grasses and other pasture plants, and after half a dozen years or so humus has accumulated to such an extent that the land may be put through a course of tillage cultivation without the use of any fertiliser but artificial manures. The seed-mixture that he uses is characterised not only by its abundance, but also by the fact that it contains the seeds of such out-of-the-way plants as burnet and chicory. Mr. Elliott is a firm believer in the ameliorative influence of deep roots on the subsoil, and certainly his pastures yield a large amount of food. He claims that the temporary leys secured under his system are much more profitable than "our two great enemies, turnips and cereals," and our national statistics show that many farmers are of the same opinion. The system has, no doubt, answered well in the comparatively cool and humid atmosphere of the Cheviot uplands, but whether it is capable of successful adoption in the drier districts of England is another matter. As Mr. Elliott has not put his system into competition with the ordinary methods of management of temporary grass land, it is impossible to say whether it is an improvement on general practice or not. Be this as it may, it does not

seem that the author has made out a case for the Board of Agriculture taking over his farm and converting it into a national object-lesson. It would be much cheaper, and quite as useful, to have his prescriptions tested on a practical scale in other parts of the country, and this the Board of Agriculture and the agricultural colleges might very well arrange to do.

Friederich Wöhler, Ein Jugendbildniss in Briefen an Hermann von Meyer. Edited by Georg W. A. Kahlbaum. Pp. 97. (Leipzig: J. A. Barth, 1900.) Price M. 2.40.

THESE letters were found amongst the Hermann von Meyer's bequest to the Munich Academy of Science, and Prof. Kahlbaum has done well by making them accessible to a larger circle in their present form.

Although A. W. v. Hofmann, in his charming work, "Zur Erinnerung an Vorangegangene Freunde" (Braunschweig: Vieweg und Sohn, 1888), has given a history of Wöhler's life, these letters to the intimate friend of his youth furnish a most interesting supplement to Hofmann's narrative, and will be particularly appreciated by the surviving pupils and friends who enjoyed the privilege of personal acquaintance with Wöhler, or the still larger number who now or in the future take an interest in the history of the early days of modern chemistry. This publication comprises letters covering but a short period, they are neither remarkable for style nor form, as they were obviously only intended for the person to whom they were addressed; but they are, perhaps, all the more valuable an this account, for they give a characteristic and life-like record. Prof. Kahlbaum, whilst scrupulously preserving the original text of the letters, has taken great pains in collecting additional information respecting the persons and places mentioned, and his copious footnotes afford a most useful framework to the letters, which in themselves give us so vivid a picture of the condition of things under which the ardent and youthful enthusiast pursued, with such eager devotion, his experiments and studies, and thus prepared himself for the high position he so soon attained amongst the leading chemists of his age. H. M.

Die Flora der Deutschen Schutz-gebiete in der Südsee. Von. Prof. Dr. Karl Schumann und Dr. Karl Lauterbach. Pp. xvi + 613, with 23 lithographic plates. Large octavo. (Leipzig: Gebr. Borntraeger, 1901.)

SINCE the acquisition of Kaiser Wilhelmsland and the neighbouring islands, German explorers and botanists have been busy working out the flora of their new possessions; and now, some seventeen years from the date of annexation, all available information is made accessible in the imposing volume under review. The immediate cause of the issue of this Flora is that the series of extensive collections that have recently come to hand necessitated a considerable volume for their adequate description. This, and the fact that the literature on the flora is much scattered, has prompted the authors to expand their undertaking so as to include the results of earlier explorations. The area dealt with includes, besides Kaiser Wilhelmsland (German New Guinea), the adjacent Bismarck Archipelago, the more westerly of the Solomon Islands, the Marshall, Caroline and Marianne Islands. In all over 2200 species are enumerated, and of these 400 are described for the first time, or have become known only from the recent collections which have led to the publication of this Flora. The species are distributed as follows:—Algæ, 222; Fungi and Lichens, 226; Bryophytes, 200; Pteridophytes, 155; Gymnosperms, 12; Monocotyledons, 392; Dicotyledons, 1000. The new forms are all fully described, whilst both for these and for all the plants enumerated, admirably full localities are given. Many of the new forms are of considerable interest, and fourteen new genera are created. There is a new species of *Cycas* occurring in the Bismarck Gebirge up to a height of 3000 ft., in habit resembling an Australian *Xanthorrhœa;* Guppy's interesting *Sararanga* (Pandanaceæ) is recorded with an extended distribution; there is a small Palm, *Dammera*, allied to *Licuala;* whilst among Dicotyledons, *Ficus arbuscula*, a fig-tree 3 to 6 feet high, may be mentioned. The new *Hibiscus papuanus* is spoken of as possessing the most strikingly beautiful flowers in the whole region. The additions to Rubiaceæ are considerable, and include *Dolicholobium Gertrudis* with curious dimorphic flowers. A second species of *Bothryocline* (Compositæ) considerably extends the distribution of a genus previously restricted to Africa. In *Psychotria myrmecophila*, from the Bismarck Gebirge, we have a new type of ant-plant with curious excavated trifid stipules, which appear to harbour ants in their recesses; its biological relations will require to be worked out on the spot.

The work contains, in addition to a brief introduction by Prof. Schumann, an interesting history of the botanical exploration of the whole region by Dr. Lauterbach, the enlightened director of the New Guinea Company. Included in the volume are twenty-three large plates, which adequately portray the characters of the more important novelties. Certainly the authors are to be congratulated upon their achievement, which is a model of what such a work should be. It will prove a boon to the local officials, colonists and missionaries, and cannot help but stimulate further research.

Fact and Fable in Psychology. By Joseph Jastrow. Pp. xi + 375. (Boston and New York: Houghton, Mifflin and Co., 1900.)

OF the eleven essays here reprinted the first seven are devoted to a common subject, viz. the so-called "occult" side of mental life and its significance for psychology. Prof. Jastrow's attitude towards the whole problem is marked by a luminous common sense which is, unfortunately, rarer even among serious psychologists than it should be. For scientific psychology the real question, as he never tires of pointing out, is not how to explain the marvels of spiritualism and allied arts, but how to account for the existence and wide diffusion of the state of mind which can believe in them. It is for the expert in conjuring tricks to show how the feats of the medium and the miracle-worker are done; the task of the psychologist is to investigate the "Psychology of Deception." Incidentally, however, such papers as Prof. Jastrow's essays on "The Psychology of Spiritualism" and "Hypnotism and its Antecedents," besides throwing light on the mental condition of the deceived, are interesting as showing how more than one famous occultist has executed his deceptions. The latter of the two papers just named brings out clearly and well the enormous difference between the spirit and methods of science and of superstition in dealing with one and the same set of facts. In the essay on "The Problems of Psychical Research" Prof. Jastrow is perhaps on more debatable ground, though his attitude seems to the present reviewer at least the only scientific one. Briefly his position may be summed up thus: the psychologist, as such, has no interest in the facts of "telepathy" except in so far as they throw light, as any facts about abnormal mental states may, on the known laws of normal mental processes. The "psychical researcher," on the other hand, thinks his facts sufficient warrant for postulating types of mental process of which normal life reveals nothing. Hence, unlike the psychologist, he approaches the facts in a non-scientific spirit. In a subsequent "Study of Involuntary Movements," conclusive experimental proof is given of the dependence of "thought-reading" performances upon unconscious movements of the muscles of the "subject" towards the object on which attention is directed. Of the remaining papers the most suggestive is perhaps that on "The Dreams of the Blind."

LETTER TO THE EDITOR.

The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Selenium in Sulphuric Acid.

WITH reference to the article in NATURE on the beer poisoning epidemic (pp. 541–542) as to the possibility of the presence of selenium, either conjointly with or preferentially to some compound of arsenic producing the calamity, the following observations may be of interest.

Some few years ago, in the course of an investigation on the inertness of the alkaline earths towards hydrochloric acid gas (*Ber. Deutsch. Chem. Ges.* xxix. 577–580), I had occasion to use sulphuric acid (labelled *puriss*) as a dehydrating agent for the gas, but after passage of the gas for some time a red deposit of selenium was invariably observed at the bottom of the Drechsel wash-bottle containing the acid.

It would, of course, be impossible now to trace the past history of such samples of acid, which might have come from several manufacturers, but these observations may show that selenium is a far more common impurity even in the best samples of acid than hitherto supposed.

Though some of the ill-informed writers and politicians of to-day might be invited, as a form of hard labour, to obtain sulphuric or any other acid in a state of purity (*credite experto*), yet it is not apparent that this acid need be used for the preparation of invert sugar to be subsequently applied to the manufacture of beer.

V. H. VELEY.

Oxford, April 6.

THE BOARD OF TRADE AND ELECTRIC LIGHTING.

THE Board of Trade has been busily engaged during the past few weeks with two inquiries of great importance to the electric lighting industry. The decision arrived at in the one of these which dealt with the maximum price to be charged for electric energy has already been referred to in our issue of March 14 (p. 474). The other inquiry, which was opened on March 1 under the presidency of Sir Courtenay Boyle, occupied the attention of the Board of Trade for six days, and has raised some points of considerable technical and scientific interest. The Board has not, as yet, given its decision, but the hearing of evidence and the pleadings have been completed, and we propose briefly to review the expert evidence in the following article.

The object of the inquiry was to consider an application to the Board of Trade, made by various electric lighting companies and local authorities, notably by the Westminster Electric Supply Corporation, for an alteration in one of the Board of Trade regulations. The regulation in question provided that "no change should be made in the pressure of the supply to any premises . . . except with the consent of the consumer." This regulation, it will be seen, gives to the consumer the absolute power to veto any change in the standard pressure of the supply to his premises, a change, for example, from 100 volts to 200 volts, which the supply company may desire to make. It was this power of veto that the companies wished to remove, and accordingly they made application for an alteration of the regulation by which for the words "with the consent of the consumer" should be substituted the words "on such terms and conditions as may be agreed upon between the undertakers and consumer, or, failing agreement, as may be settled by an arbitrator appointed by the Board of Trade," or words to that effect.

The difficulties which have led to this inquiry have all arisen out of the change from a 100-volt to a 200-volt supply which is being made by the Westminster and other electric light supply companies. The change was started in the case of the Westminster Corporation, which we may take as a typical instance, in 1896, and their reasons for making it were as follows. The system, as originally laid down, was a three wire system with 100 volts between each outer conductor and the middle; by 1895 the demand for electric light had increased so much that the street mains were beginning to get overloaded, that is to say, the current which they were obliged to carry was more than was economically good. The evil of this overloading was shown in two ways: on account of the heavy current which the mains were carrying the loss of energy in them, which is proportional to the square of the current, was very great, amounting, in fact, to about 12½ per cent. of the total output; also the drop of voltage in the mains was considerable and made it increasingly difficult to maintain the voltage at the consumer's terminals within the limits of variation allowed by the Board of Trade. In these circumstances, the supply company was faced with a difficulty which could be overcome only in two ways. Either they could put down fresh mains year by year to meet the increasing demand, a proceeding which would involve an expenditure of something like 7500*l.* a year, or they could supply the same amount of energy, using a smaller current and a higher voltage. If the voltage were doubled the same amount of energy would be supplied by only half the current, and the energy loss in the mains would be only one-quarter of its former amount; the drop of voltage would at the same time be halved (the percentage drop being therefore only one-quarter of its former value), and thus the second difficulty referred to above would be avoided. It is perfectly evident, therefore, that from the supply company's point of view the best course to adopt was to increase the standard voltage of the supply. And indirectly, also, this course must be beneficial to the consumers, and prospective consumers, for anything that tends to cheapen the cost of supply to the company tends also to lower the price the consumer has to pay for the energy he uses.

The consumer has, however, another way in which he can look at the question. It is not simply energy that he wishes to buy, but energy that can be economically converted into light; in fact, he really wants simply to purchase light. If, therefore, the 200-volt lamp is less efficient than the 100-volt lamp, it may be to his disadvantage to have to use energy at 200 volts, even though the cost of such energy may be less. For example, if we may state a similar case, it is not an advantage to a consumer to be obliged to drink arsenical beer, although the cost may be less than that of pure beer. In addition, the change necessitates, in most cases, refitting and rewiring of the premises, since the fittings that are suitable for 100 volts, especially if they are of old patterns, are not good enough for 200 volts, and also the wiring is often not good enough for the higher pressure. The question of the liability of the supply company for the costs of these alterations and for the inconvenience caused by the necessity of making them is, however, one which can reasonably be settled by arbitration. The matter of prime importance to the consumer is, we consider, the question of the inferiority—real or alleged—of the light obtained with 200-volt lamps.

Before the Westminster Corporation decided to make the change, they ascertained to their own satisfaction that the 200-volt lamps were as good as the 100-volt, or, if not as good, so little inferior that the disadvantage was more than counterbalanced by the lowering of the price charged to the consumer. This is a point, however, on which doctors disagree, as was shown by the expert

evidence at the inquiry, and it is interesting to note the grounds given for the various opinions held.

Prof. Kennedy, who is adviser to the Westminster Corporation, advanced the argument that if the 200-volt lamp were really less efficient than the 100-volt, then the consumption of energy per lamp connected to the mains should have steadily increased since 1897, as more and more consumers were changed over to the higher pressure. But this argument is, as Prof. Ayrton pointed out, quite fallacious; if the consumer is supplied with a 200-volt so-called 8 c.p. lamp, which is, in reality (as in an actual case quoted by Prof. Ayrton), only giving a candle-power of 1·8 and is consuming 15·3 watts per candle, it will only consume 28 watts; the consumption of energy is therefore rather less than with a 100-volt 8 c.p. lamp giving its correct candle-power and consuming 4 watts per candle. The consumption of energy per lamp in cases like this goes down, from which Prof. Kennedy would argue that the efficiency has gone up; whereas, as a matter of fact, it has diminished enormously, the effect appearing, not in an increased bill, but in a decrease of light. As a matter of fact, this is the way in which the inefficient lamps show their badness; they do not maintain their correct candle-power and take more watts, but they fall off in candle-power for the same consumption of energy. This was exemplified in the evidence given by Mr. B. M. Drake. Most engineers and lamp-makers call the watts consumed per candle by the lamp its efficiency, though, as a matter of fact, this quantity is a measure of the inefficiency. Mr. Drake prefers to measure the inefficiency by the complaints received per customer, and there can be no doubt that, though unscientific, this is a very good way of getting at an average value. According to this standard, Mr. Drake finds that the 200-volt lamp is much inferior to the 100-volt.

There was not wanting evidence in favour of the 200-volt lamp, but the majority of the experts, certainly in the cases in which the results of actual tests were given, were against it. To take one other instance, Mr. Gunyon, on behalf of the London County Council, gave evidence to the effect that the 200-volt lamp cost more, lasted for fewer hours, and was less efficient than the 100-volt; he gave the results of tests on four different makes of 200-volt lamps, the average consumption of energy in the *new* lamps coming out at 5·4, 4·1, 5·8 and 5·6 watts per candle respectively, the good value (4·1) being for a foreign make of lamps. These figures show that lamp-makers have by no means yet got over the difficulties of the manufacture of the 200-volt lamp which were pointed out by Mr. Byng in a paper read before the Institution of Electrical Engineers three years ago (*Journal* of the Institution of Electrical Engineers, 1898, vol. xxvii. p. 118). That they will ultimately triumph over the difficulties all must hope; that they have satisfactorily done so now cannot, we think, be maintained.

The inferiority of the high-voltage lamp is, however, as we have pointed out, not the only consideration; the change is, without doubt, beneficial to the supply company, and it must, moreover, be remembered that in many cases the change has been all but completely carried out. The Westminster Corporation have only some half a dozen consumers who are still being supplied at the low pressure; the remainder, either through choice, through indifference, or through ignorance of their power to refuse, have submitted to the change. No doubt these few outstanding consumers are an annoyance to the company and a source, possibly, of loss, although the company have raised the price they are charging them to the maximum allowable; yet we cannot help sympathising with the consumer who objects to being compelled to use what he honestly, and with justice, believes to be a worse article.

SEISMOLOGY IN JAPAN.

THE chief interest attached to the publications mentioned below[1] is the fact that while giving us an insight into the attitude taken by the Government of Japan in regard to seismology, they form an important link in the history of the modern development of that subject.

On February 22, 1880, a rather severe earthquake so far excited the curiosity of the inhabitants of Tokyo and Yokohama that, with the object of studying such tremblings, a Seismological Society was founded. This society existed for twelve years and published twenty volumes. The usefulness of its work, attracting the attention of the Japanese Government, led to the establishment of a chair of seismology at the Imperial University, and the organising of a bureau which now controls nearly 1000 observing stations. The next great stimulus that seismology received came from the terrible disaster of October 28, 1891. Ten thousand persons were killed, more than fifteen thousand were wounded, and thirty million dollars' worth of property were destroyed. A comparison of the buildings which remained standing with those which were shattered and those which were utterly ruined indicated that something might be done to minimise such disasters, and to accomplish this, by virtue of an Imperial Ordinance, on June 25, 1892, an Earthquake Investigation Committee was established. This body consists of some twenty-eight members selected from amongst the best-known engineers, architects and men of science in Japan. Two well-known names—Prof. D. Kikuchi and Dr. F. Ōmori—appear as president and secretary. The *modus vivendi*, which can be seen in the Parliamentary Budget, seems to have an annual variation of from 1000*l.* to 5000*l.* Amongst the various investigations which this committee proposed to undertake we find the following:—

To collect documents relating to seismology and volcanology; to draw up a statistical account of seismic phenomena in Japan, such, for example, as might be required by insurance companies whose risks extend to disasters caused by earthquakes; to conduct geological researches bearing upon seismology; to extend our knowledge respecting the nature of earthquake motion; to determine the velocities with which earthquakes are propagated from point to point; to make observations on changes in the vertical and earth "pulsations"; to compare the movements resulting from given earthquakes as recorded on the surface of the earth and at depths which are comparable with the depths to which foundations of buildings may be carried; to extend observations on the variability of magnetic elements, there being reasons to believe that these may hold a certain relationship to seismic activities; to observe changes in temperature at great depths; to determine strength constants for building materials produced in Japan; to measure accelerations and maximum velocities necessary for the shattering, overturning or projection of various bodies, amongst which no less than sixteen types of model houses are specified; to erect buildings specially designed to resist earthquakes; to study the effects of earthquakes on modern construction; and generally the committee undertook to make any investigation which may ultimately result in reducing the loss of life and property which so frequently accompanies violent earthquakes.

Although only nine years have elapsed since this elaborate programme was formulated, every item in it has received serious attention.

From volumes iii. and iv. we see that Profs. Tanabe and Mano have worked at the strength constants of

[1] Publications of the Earthquake Investigation Committee in Foreign Languages. No. 3, pp. 103; No. 4, pp. 141; No. 5, pp. 82; and No. 6, pp. 181. (Tokyo, 1900–1901.)

building materials, and investigated the effects of several earthquakes upon tall chimneys. Dr. B. Koto has handed to the committee twenty-two papers on geological subjects connected with seismology and volcanology. Dr. H. Nagaoka gives a paper of intense interest to all physicists on the determination of the elastic constants of rocks; whilst the well-known professor of seismology, Dr. F. Ōmori, contributes six papers, each of importance to seismologists, and for the most part indispensable to those who have to construct in earthquake countries.

Volumes v. and vi., which contain the analysis of the diagrams of 246 earthquakes observed in Tokyo between July 1898 and December 1899, are entirely from Dr. Ōmori's pen, and although we may not concur in all the results he sets before us, seismologists in general must thank him for the vast quantity of material which he has brought together and systematised for their consideration. For the earthquakes which originated at great distances from Japan, so far as possible each seismogram has been divided into parts which succeed each other in the following order: "First preliminary tremors," in which waves of 4 seconds period are superimposed upon those of 8 seconds; "second preliminary tremors," with periods of 8 seconds, and accompanied by undulations of 14, 25 and 66 seconds period; "the principal portion" of the earthquake, which is divided into three phases also dependent on period, and finally the "end portion," in which period is fairly regular. The regularity of the terminal vibrations may, as Dr. Ōmori remarks, be explained on the assumption that different portions of the earth's crust have particular periods of free oscillation. The discussion of these various types of earthquake motion is based on the assumption that the waves recorded are *horizontal movements and not tiltings of the ground.*

One observation which led Dr. Ōmori to take this view is that he has obtained seismograms which show that the amplitude of motion depends upon the multiplication ratio of the writing pointers attached to his pendulums, and not upon their sensibility to tilting. In addition to this he points out that if the undulations recorded were due to tilting, then the accelerations involved are such that our sense of feeling should be affected, which is not the case. Since Dr. A. Cancani, in 1893, drew attention to the fact that calculations based on a knowledge of the period, velocity and maximum tiltings of these unfelt undulations led to the conclusion that the inhabitants of the world were raised and lowered two or three feet hundreds of times per annum and had never observed the same, seismologists have regarded with suspicion the elements in the calculations leading to these results. Notwithstanding this, when we have so very much evidence of turbulent wave-like motion in and around epifocal districts, and evidence of repeated tiltings at distances of several hundred miles from the same, it is difficult to escape from the conclusion that similar but slower period movements may be propagated, like a swell upon an ocean, to very distant places, and seismographic pendulums be caused to swing.

Dr. Ōmori has certainly thrown new light upon the nature of the large waves, and it does not seem improbable that investigations carried out upon other lines may, if not completely at least partially, confirm his views.

A more debatable subject touched upon relates to paths followed by earthquake waves through the earth's crust. Because the velocity of the quick period phase of the large waves nearly equals that of local earthquakes, it is assumed that the former, like the latter, are propagated along the surface of the earth's crust, whilst waves which precede them travel at some small depth in the same. Inasmuch as the first preliminary tremors have, at a given station, a duration proportional to the arcual distance of this station from the origin of the earthquake, Dr. Ōmori thinks it likely that they are transmitted along paths nearly parallel to the surface of the earth, and at a probably constant depth.

Several sections in vol. v. refer to subjects which are not seismic, although they are of great interest to those engaged in certain branches of physical research. For example, references are made to the effect of slight loads upon masonry structures, whilst "oscillations of the ground," whose origin is not seismic, are discussed at some length. That we have for years past been acquainted with movements of pendulums and balances not proper to those of the instruments themselves, which may continue for hours or days, suggests the question whether we are not here being re-introduced to an old enemy in a new dress. Are these movements due to those of the ground or to local movements in the atmosphere? Can Dr. Ōmori assure us that similar instruments, placed in different rooms or under conditions which are different with regard to temperature and ventilation, behave similarly? If this be the case, then the distinction which has so frequently been drawn between "pulsations" and "air tremors" will be more clearly established. In a stable at Shide "air tremor" effects are, at certain seasons, frequent, whilst at times pendulums with a 15 seconds period will yield diagrams showing that they have been moving regularly with a period of two or three minutes. In an adjoining coach-house these movements are absent, and similar phenomena are common to Tokyo and other places.

What has here been said indicates the nature of the work now in progress in Dai Nippon, a complete account of which is to be found in thirty-two well-illustrated quarto volumes, which, unfortunately for Europeans, are written in Chinese characters. These volumes are with but little doubt one of the greatest store-houses extant of information relating to practical seismology, and as such it is to be hoped that an abstract, or at least a table, of their contents may be published in a European language.

As an example of their value we may select vols. xxii. and xxv., referring to an earthquake which in 1897 devastated North-Eastern India, and cost British investors and taxpayers several millions sterling. The first of these is by Dr. T. Nakamura, an architect, and it contrasts those forms of structure which withstood the effects of the earthquake with those which failed. The second, which treats of railway and bridge construction, is by Mr. T. Koyama, a railway engineer. These gentlemen are two out of four who were sent to India by their Government for the purpose of increasing their own extensive knowledge as to forms of structures most suitable for earthquake countries. On this occasion, as in others, special men were selected for special work, with the result that, not only has Japan profited by disasters of this character, but she has become a teacher of nations in practical seismology, and we, amongst others, may offer her thanks and congratulations on her efforts to save life and property.

J. MILNE.

THE EYE IN THE RECENTLY DISCOVERED CAVE SALAMANDER OF TEXAS.[1]

THE tailed Batrachia have during recent years attained an increased importance zoologically, by appreciation of the fact that in respect to many features in which their living representatives present a simplification of organisation they are retrograde. While but one of them possesses a complete maxillo-jugal arch, none are pentadactyle in both fore- and hind-limbs; and the unexpected has been reached, in the discovery that there

[1] "The Eyes of the Blind Vertebrates of North America," by C. H. Eigenmann (*Trans.* Americ. Microsc. Soc., vol. xxi. pp. 49-60), by C. H. Eigenmann and W. A. Denny (*Biological Bulletin*, Boston, U.S.A., vol. ii. pp. 33-40)

are no fewer than ten species of six genera which are lungless, and that in some of these respiration is largely buccal or pharyngeal, and may even, in all probability, involve the tips of the toes, as in *Autodax* and species of other known genera.

Conspicuous among recently discovered species are three of American origin which are cave-dwellers. Of these, one (a *Spelerpes*), occurring in the Mississippi Vale, has nondegenerate eyes; another (*Typhlotriton*), more restricted in the same region, has eyes which during growth undergo a recognisable degeneration. The third (*Typhlomolge*), discovered in 1896 in the underground waters of Texas, where it was obtained from an artesian well, said by our authors to be now thrown up at the rate of about fifty a year, is quite blind, possessed of functionless eyes. It is with the paper upon this genus that we have chiefly here to deal. The animal itself is of especial interest, as furnishing the much-desired American counterpart for the European *Proteus* long known. It differs from this, however, in being shorter bodied and longer limbed—so much so that the limbs appear by attenuation to have become converted into tactile organs—and the discovery that the eye is destitute of lens, rods and cones, and eye-muscles (which is the most interesting fact announced in these papers) is thus intensely significant, as it presents us among the Batrachia with a condition recalling that of the famous blind locust of the New Zealand caves, in which, under the functional atrophy of the eye, the antennæ have similarly become elongated and more important.

The second paper deals with the eye of the Mississippi cave salamander *Typhlotriton*, which, while "detecting its food by the sense of touch," shows only the first stages of that degeneration of the eye and its associated organs occurring in the Typhlomolge type. Both papers are illustrated, though very poorly, and they do not in this respect compare with previously published works on other blind animals which might be cited. Moreover, there is in the first paper an inexplicable error, for the senior author, stating that "the eye of Typhlotriton will be dealt with in another place" (*i.e.* the second paper herein quoted), continues erroneously to use this generic name in describing the Typhlomolge eye.

Typhlomolge is in every respect a most remarkable creature, as examination of the example preserved in our National Museum at South Kensington will show. The description of its eye, coming to us at a time when there has just been found (in the French Congo area) a frog in which the terminal phalanges of four of the hinder digits, perforating the overlying integument as do the ribs of the long-known Pleurodile Newt, project, freely and exposed, as sharply recurved claws. All this brings forcibly before us the lesson that in morphologically specialised forms of life, such as we are too apt to pooh-pooh, there are to be found facts which, on the whole, are among the most trustworthy, in enabling us to gauge the limits of nature's operations. Truly has Weismann remarked (as pointed out by the senior author in his 1899 Woods' Holl Lecture on "The Blind Fishes") that "an investigation into the history of degenerate forms often teaches us more of the causes of change in organic nature than can be learned by the study of the progressive ones."

G. B. H.

THE COMMERCIAL USES OF PEAT.

THE difficulty in obtaining coal for industrial purposes, and the high price that has had to be paid for it recently, especially where works are situated at long distances away from the mines, has led to more attention being paid to the use of peat for fuel. In the "Notes" of May 31, 1900 (vol. lxii. p. 108), a short description was given of the uses to which peat was being applied in Austria in the manufacture of textile fabrics. In a recent number of the *Engineer* (February 8, 1901) an account was also given of the peat fuel industry in Sweden. It is said that there is hardly any question of the day so prominent in that country as the use of peat fuel as a substitute for coal. The Government, recognising the importance of this matter, has appointed a Crown Peat Engineer, at a salary of 500*l.* a year, to survey the principal Crown peat bogs and to report upon the quality and suitability of the peat for use as fuel in locomotive engines. At several of the large works in Sweden peat is now used for generating steam. At the great Yungtell Metal Works and the Motala Shipbuilding Works, it is also used in generating furnace gases, the fuel being prepared by specially constructed works. At the former establishment, engines of 230 horse-power are supplied with steam generated by this fuel. In the province of Smaland a syndicate has recently purchased the peat bogs, from which it is estimated that a million tons of fuel will be produced in a year. At the Karpalund sugar refinery peat is now solely used for the nine boilers in use there of 100 horse-power each; the fuel being first converted into gas in generators in front of the boilers. This establishment has purchased an adjacent bog containing sufficient peat to supply the works for twenty years. The bog is connected with the factory by a Decauville railway. The furnaces were formerly fed by coal obtained from England, and a very great saving has been effected, the peat fuel costing less than half that of coal. On several of the railways peat is being tried as fuel for the locomotives with every promise of permanent success. There are several different kinds of machines for making this fuel. The process something resembles brick-making. The turf is cut from the bog either by manual labour or machinery, and stacked in summer to be air-dried, any remaining moisture being removed in heated drums or by centrifugals, and the peat is then compressed into briquettes. It is claimed that one ton of dried peat from the best class of bogs is equal to half a ton of English coal.

The largest area of peat in England is to be found in the Fen district, where it covers 600 square miles and the depth varies from 2 to 10 feet in thickness, and at Whittlesea Mere as much as 18 feet. Nearly the whole of the peat in the Fenland has been drained and is now cultivated.[1] In a few places in the Fens it is sun-dried and used for fuel. In the form of powder and mixed with carbolic acid it is also extensively used as a deodorant for earth closets and similar purposes, works for this purpose being established in Cambridgeshire.

There are also large deposits in the East Riding of Yorkshire along the valleys of the Trent and Ouse, Hatfield Chase covering 12,000 acres, where a manufactory has been for some years in existence for drying and preparing the peat for litter for stables and cow-houses. Its antiseptic properties make this litter very valuable, especially in large towns where straw is difficult to obtain. There are also large areas of peat in other parts of the country, as at Chatmoss in Lancashire and on Dartmoor.

In Ireland, the peat bogs cover about 5000 square miles, or about one-seventh of the whole country; some of the bogs are 43 feet deep, the average thickness being 26 feet. Occasionally, owing to an excess of water, the peat overflows the basin in which it is contained and flows over the cultivated land. Thus a few years ago the bog near Tullamore overflowed and covered nearly three square miles of land. Sun-dried peat is used in Ireland to a considerable extent for fuel. Some attempt has been made to work it for commercial purposes. The Irish Amelioration Society some years ago encouraged the conversion of it into charcoal, but the process was

[1] "The History of the Fens of South Lincolnshire." (London: Chapman and Hall.)

not found to pay commercially, although peat charcoal is well adapted for working and tempering iron for the finer kinds of cutlery. The Irish Peat Company erected extensive plant for drying and distilling the peat and producing tar, illuminating oil and paraffin. At these works, one ton of peat yielded 10 gallons of tar, or 28 lbs. of illuminating oil and 1 lb. of paraffin.

One of the last volumes of the Encyclopédie Scientifique, published in Paris,[1] is devoted to a treatise on peat and peat bogs. It describes the conditions under which peat was originally formed, the plants of which it is composed, the chemical analysis of its constituents, the principal bogs in Europe, the age of peat as deduced from the remains of animals, flint implements and tools found buried in it, the methods of obtaining and preparing peat for commercial purposes, the uses to which it is applied and its calorific value and antiseptic qualities.

W. H. WHEELER.

THE BRITISH AND GERMAN ANTARCTIC SHIPS.

THE two great Antarctic expeditions have made a stride towards completeness by the launch at Dundee and Kiel of the exploring ships *Discovery* and *Gauss*, both vessels built, at great expense, specially for service in the Antarctic ice. No complete official announcement of the organisation and programme of either expedition has yet been made. However, the two ships are afloat, and appear to be the finest vessels for ice-navigation ever constructed, not even excepting the *Fram*, which of course was planned for drifting with the ice-floes, not for sailing through them.

The following table compares the chief dimensions of the two vessels, so far as we have been able to ascertain them :—

	Discovery.	*Gauss.*
Length over all ... ... (feet) ...	—	168
,, at water line ... ,, ...	172	—
,, between perpendiculars ,, ...	—	151
Extreme Breadth ... ... ,, ...	34	35
Probable displacement fully loaded (tons)	1750	1450
Horse-power	450	300-500
Rig	Barque	Barquentine
Complement all told (souls)	46	28

It is stated the name of *Gauss* was given to the German vessel by the Emperor to emphasise the scientific character of her mission by associating it with the memory of the great authority on terrestrial magnetism.

The German vessel, although a little smaller than the *Discovery*, is intended to carry so much smaller a crew that she will probably prove to be no more crowded with her stores and equipment. Both vessels are strongly built of oak and sheathed in greenheart. The *Discovery*, like the *Fram*, has her frames in contact throughout her whole length, and the joints caulked so that even if all her triple skin of planking were stripped from her the vessel would still be watertight and seaworthy. She is of whaler pattern to the extent that her sides are not pierced by any openings, the only daylight for the cabins coming from deck-lights ; but the cabins, though dark and uninviting at the launch, are exceptionally roomy and well-planned, and when lighted by the electric light will be extremely comfortable. The *Gauss* is also to be furnished with the vital necessity of electric light, a boon that none but polar voyagers can fully appreciate, and she is, in addition, to have the luxury of steam-pipes for heating purposes throughout the whole inhabited part of the ship ; the *Discovery* will probably be heated by stoves.

Both vessels are provided with wells and gear for hoisting out both rudder and propeller, and a spare rudder will be carried which can be shipped securely and speedily if the original steering gear should be seriously damaged. The bows of both ships are heavily plated with steel to enable them to cut through or break comparatively thin ice ; but the form of the stem is different. Both have a great sheer, so that the vessel would tend to ride up on any floating ice she encountered and break it with her weight, but the stem of the British ship is a straight line forming an obtuse angle with the keel, while that of the German vessel is a convex curve. The sterns also differ, that of the British vessel having a much longer overhanging counter than the *Gauss*, so that her length over all is probably from 15 to 20 feet greater.

The details of laboratory accommodation can be more profitably described when the space is finally apportioned and the equipment in place ; but the magnetic observatory on the *Discovery* has been very carefully planned so that it shall be more than 30 feet from any iron or steel —even the bolts and nails in its vicinity are all of brass.

The living rooms in both vessels are amidships, the stokehold and engine-room being placed right aft, while the whole lower hold is utilised as a great coal-bunker along the length of the ship. The *Discovery* is rigged as a barque ; the rig of the *Gauss* is officially described as that of a "three masted schooner," but her published sail-plan shows the foremast completely square-rigged, the main and mizzen having only fore-and-aft sails, so that she is better called a barquentine. We believe that this rig, rendered necessary probably on account of the small crew carried, is not a usual one for polar ships. Machinery and masts are now being rapidly put in place, and the *Discovery* may be expected in the Thames to take her stores on board about the end of May or early in June.

MEETING OF THE INTERNATIONAL ASSOCIATION OF ACADEMIES.

THE business of the Paris meeting of the International Association of Academies was commenced on Tuesday morning, when the delegates assembled at the Institute. The delegates were received, on Saturday, by the president ; and the French Government, as well as the Municipal Authorities, have combined with the Institute to make the meeting a success by facilitating all the arrangements and providing lavish entertainment. By this official action, the dignity and importance of the meeting are declared, and the delegates are made to feel that they are welcome visitors.

Tuesday's meeting was devoted to preparatory business, and M. Darboux gave an address on the objects and work of the Association. The financial position was considered, and suggested additions and alterations of the rules were discussed. A committee was appointed to consider a scheme for the mutual loan of manuscripts. In the evening, the president of the Institute, Count de Franqueville, gave a reception to the delegates and their families at his residence, the Château de la Muette. Yesterday the arrangements included a visit to the Château of Chantilly, bequeathed to the Institute by the Duc d'Aumale. This afternoon there will be a reception by M. Émile Faguet at the French Academy, and in the evening a dinner will be given by the Institute. On Saturday afternoon a visit will be made to the National Library, under the direction of M. Léopold Delisle, and on Saturday evening the Municipal Council will give a dinner to the delegates and members of the Institute. The dinner will be followed by a reception and concert, to which the families of the guests are invited. On Sunday a special piece will be represented at the Comédie-Française in honour of the delegates.

From this programme it will be seen that the serious

[1] "La Tourbe et Les Tourbiéres, par Alb Larbalétrier. Encyclopédie cientifique des Aide Memoire." (Paris : Masson et Cie.)

work of the meeting will be relieved by congenial entertainment. The way in which the various authorities, as well as private individuals, are contributing to make matters run smoothly, and to ensure that the delegates shall remember their visit with pleasure, is a noteworthy characteristic of the arrangements.

NOTES.

IT appears that the Bement collection of minerals, which became the property of the American Museum of Natural History at the end of last year, was presented to the museum by Mr. J. Pierpont Morgan. The collection is estimated to be worth about 40,000*l.*, and was commenced by Mr. C. S. Bement, of Philadelphia, who began it thirty-five years ago and kept adding to it until it passed from his possession. Neither time nor money was spared in gathering desirable specimens, and in 1884 the Bement collection was looked upon as so important as to be made the subject of a special report in the interest of the National Museum, Washington. Mr. Morgan's public spirit and generosity have prevented the collection from being distributed or from leaving the United States. In addition to this gift, he has presented to the museum the Tiffany collection of gems. Mr. Morgan's earlier contributions to the museum, of which he is a trustee, have been on a munificent scale, but the recent gifts surpass previous ones in value and scientific interest. Referring to the gifts at a recent meeting of the Board of Trustees, Mr. A. S. Hewitt remarked :—"The trustees rejoice that the museum begins the new century with the acquisition of two very remarkable, if not unique, collections of minerals, which, added to the treasures already in its possession, raise its position among the museums of the world to the level occupied by the British Museum, heretofore, by common consent, regarded as rich beyond comparison in rare specimens.

WITH reference to the recent proposal to stock the London parks with butterflies, Prof. Meldola writes to say that the experiment, although worth trying, is not, in his opinion, likely to prove successful. The species which have been observed in the Metropolis are, with the exception, perhaps, of *Pieris rapae*, only casual visitors, for the most part imported and only occasionally immigrating spontaneously. It is very doubtful whether the species which it is proposed to introduce, viz. the *Vanessas*, would survive more than the first season, and if any should escape the London sparrow and hibernate it is more than probable that they would voluntarily migrate the following spring to fresher surroundings than could be offered by a vegetation which had gone through the ordeal of a London winter. Prof. Meldola adds that in the year 1871 he perfectly well remembers the leopard-moth, *Zeuzera aesculi*, being quite common on the tree-trunks in the London parks and squares. It was observed during that season that the ground at the foot of the trees was often littered with wings of the moth, as though some bird—probably the sparrow—had been at work among the insects. If the suggestion to stock the parks necessitated an annual renewal of the butterflies, it would be better to leave them in their native country haunts.

IT is stated that the Cunard Company contemplate utilising the Marconi wireless telegraph on their Atlantic steamers.

MR. C. E. BORCHGREVINK, the Antarctic explorer, has been created a Knight of the Order of St. Olaf by King Oscar.

MR. J. WILSON, U.S. Secretary of Agriculture, has arranged to carry into effect, on July 1, the reorganisation of certain of the divisions of the Department of Agriculture, as provided by the last Congress. It may be remembered that, in addition to the Weather Bureau and the Bureau of Animal Industry, four new bureaus were created, namely, those of Plant Industry, of Forestry, of Chemistry and of Soils.

WE learn from *Science* that an influential committee has been formed in Italy to celebrate the fortieth anniversary of Prof. Paul Mantegazza's entrance on his career as a teacher. This event will be celebrated at Florence on April 30, and at the same time as the thirtieth anniversary of the Italian Society of Anthropology. It is proposed to collect a sum of money to be used for the endowment of the new laboratory of anthropometry which Prof. Mantegazza has established at Florence.

THE Rome correspondent of the *Times* records the opening, by Lord Currie, of the British Archæological School in Rome. More than one hundred representatives of international archæology gathered at the Palazzo Odescalchi, where the school is situated, the Italian Government being represented by Commendatore Fiorilli, Director-General of Antiquities and Fine Arts, the Academia dei Lincei by several members, the German Archæological Institute by Profs. Petersen and Hülsen, and the French École de Rome by Mgr. Duchesne.

SEVERAL papers on scientific aspects of alcoholism were read at the International Temperance Congress held at Vienna last week. Among the subjects described and discussed were the effect of small fixed quantities of alcohol on the speed and quality of certain simple and calculable mental operations, such as sums in addition, and committing figures to memory; the poisonous effects of alcohol in certain nervous affections; the effect upon the power of resistance to disease; remedial measures; and reforms recently introduced into the French Army for the repression of alcoholism.

IT has been decided (says the *Victorian Naturalist*) that the National Fund raised in memory of the late Baron von Mueller, Government Botanist of Victoria, shall be devoted to the institution of a medal and prize to be awarded at intervals of not less than two years to the author of the most important contribution to natural knowledge which shall have been published in the British dominions not more than five years, or less than one year, prior to the date of the award, preference being given to work having special reference to Australasia. It is proposed that the Mueller Medal shall be awarded by a committee of the Australasian Association for the Advancement of Science appointed for the purpose every two years.

FROM the *Victorian Naturalist* we understand that Prof. Spencer, F.R.S., of the Melbourne University, and Mr. F. J. Gillen, of South Australia, will start from Oodnadatta, the present terminus of the transcontinental railway, nearly 700 miles north of Adelaide, on their expedition for the purpose of studying the habits and customs of the aboriginals of the northern portion of Central Australia, about the middle of the present month. The start has been somewhat delayed owing to the drought which has existed for some time in the portion of the continent to be visited. It is also proposed to cross into Queensland and continue Dr. Roth's ethnological work, and afterwards to traverse some of the larger rivers of the Northern Territory, and if time permit, to visit the Wyndham district on Cambridge Gulf in North-West Australia.

A COMMITTEE, to be known as the Lightning Research Committee, has been organised by the Royal Institute of British Architects and the Surveyors' Institution, with the object of collecting and tabulating information from all parts of the country as to damage resulting to buildings from lightning. The committee includes Mr. John Slater (chairman), Major-General E. R. Festing, C.B., F.R.S., Dr. Oliver Lodge, F.R.S., Messrs. J. Gavey, W. P. Goulding, W. N. Shaw, F.R.S., H. H. Statham, A. R. Stenning, Arthur Vernon, Killingworth Hedges, C.E. (hon. secretary). In pursuance of their inquiry the committee seek the co-operation of competent observers in all parts of the country, with a view to obtaining accurate

details, noted on the spot, of the effect of lightning-strokes on buildings, whether fitted with conductors or not. Persons willing to assist by their observations are invited to communicate with the secretary at the offices of the Royal Institute of British Architects, 9 Conduit Street, London, W.

WE learn from the *British Medical Journal* that in the course of the present year a statue of Pasteur is to be erected in the town of Dôle, in the Jura Department, which was his birthplace. The statue, which is from the chisel of M. Antonin Carlès, is in bronze, and stands on a conical pedestal 8 metres high. Pasteur is represented as standing in an attitude of meditation. At the base of the monument is a group representing Humanity holding out two children to Pasteur, whilst Science offers him a palm.

THE death is announced in the *Times*, at the age of ninety-three years, of Prof. Paul Chaix, a well-known citizen of Geneva and a geographer of distinction. In 1836 he was appointed master of geography and history in the Industrial College of Geneva, and in 1868 he became professor at the Gymnasium, and a few years later at the University. M. Chaix was an active member of the German Geographical Society, and an honorary corresponding member of the Royal Geographical Society. He was the author of a map of Savoy, a history of Central America, various elementary geographical works, and papers to geographical and other journals.

THE Paris correspondent of the *Chemist and Druggist* announces the death, at Grenoble, of Prof. F. M. Raoult, an eminent chemist and senior of the Faculty of Sciences of that town. He was a corresponding member of the Paris Academy of Sciences, a foreign member of the Chemical Society, London, and of the Imperial Academy of St. Petersburg, and a Commander of the Legion of Honour. M. Raoult was 71 years of age, and held a high place amongst French chemists. The death is also announced of M. Maxime Cornu, a well-known French botanist, who took a leading part in the endeavours to eradicate phylloxera in France. The deceased was a professor at the Paris Museum of Natural History, and contributed largely to the literature of botany.

IT is a matter for congratulation that serious efforts are being made by the municipal authorities in many civilised countries to combat disease by all means available for that purpose. We therefore welcome the news that an excellent institution for the exclusive treatment of patients suffering from the various forms of cancer—either curable or incurable—is being built in Moscow at the expense, which is said to be an enormous one, of the municipality of that city. It is understood, however, that the main object of erecting this special hospital is to provide the necessary means of studying the nature of cancer from every possible point of view and of enabling and encouraging more thorough pathological and clinical research to be carried out in connection with that malady. Accordingly, we may reasonably hope that by carefully conducted scientific investigations the light of knowledge will be thrown upon a scourge which has, of late years, and particularly in the northern regions of the Russian Empire, assumed a most formidable extent and character. It may be added that the new institute will be under the entire management of a committee consisting of several members of the medical faculty, with Dr. Lewschin, professor of surgery in the University of Moscow, as its director. In addition, facilities will be offered to students who, desirous of joining the scientific circle of investigators there, have already proved themselves efficient workers in that department of pathological research.

THE very alarming reports which were published by the German Press towards the end of March concerning both the extent and rapidity with which the recent outbreak of an epidemic of enteric fever in Upper Silesia had spread throughout that country, and particularly the serious complications and the high rate of mortality by which it was followed, have prompted the Prussian "Cultusminister" to request Prof. Robert Koch to proceed at once to that part of the German Empire for the purpose of ascertaining the original source of the infection and of adopting some trustworthy measures to check its further present spread, and to prevent, as far as possible, its occurrence in the future. Prof. Koch, it is reported, will now leave Berlin for Beuthen, which is situated near the Polish frontier, where he will, in the first instance, examine the so-called "hygienic station," which was erected there for bacteriological purposes some years ago, whence he will proceed to the other more important places and towns of Silesia with a view to inspecting carefully their present sanitary conditions. It is believed that Prof. Koch will be engaged on his mission for from six weeks to two months; subsequently his report, which, it is understood, will cover all the main points of his bacteriological investigations bearing upon enteric fever, will be published by the Reichsgesundheitsamt of Berlin.

REPRESENTATIVES of several societies interested in archæology met Sir Edmund Antrobus on Friday last at Stonehenge to discuss the details of the resolutions passed at the recent conference in London, and referred to in our last issue (p. 576). The *Times* reports that all the details of the work it is proposed to do with the view of maintaining the stones in a position of safety were fully discussed, and the representatives present unanimously approved all the suggestions made at the London conference. It was decided to proceed with the work as soon as the weather is favourable. It will be carried out under the supervision of Mr. Delmar Blow, assisted by an eminent civil engineer; and nothing in the way of restoration will be attempted. The only object the societies have in view is the preservation of this ancient memorial. The first work to be undertaken will be the raising of the huge monolith, which overhangs the altar stone and is in a most dangerous condition, into an upright position. It is the largest and finest monolith in England next to Cleopatra's Needle. At present it rests on a smaller stone, but there are two large flaws or cracks in it, and if it were to fall it is feared that it would be broken into three parts. The experts engaged in the work will next proceed to examine the stones numbered 6 and 7 on Mr. Petrie's plan, with the view of putting them in a position to support the lintel which rests upon them. The other recommendations of the societies will be carried out in due course; and, in the meantime, Sir E. Antrobus hopes to obtain permission to divert the roadway now passing through the earth-circle which surrounds the stones, and to proceed with the erection of the wire fence approved by the conference.

M. DE FONVIELLE, ex-president of the French Society for Aërial Navigation, delivered an address upon the position and progress of aëronautics in France, at a meeting of the Aëronautical Society held at the Society of Arts on Monday. In the course of the address, M. de Fonvielle referred to several important matters requiring the consideration of meteorologists, astronomers and others interested in scientific ballooning. One refers to the time at which the balloon ascents are made in connection with the International Aëronautical Committee. The balloons are sent up about eight o'clock in the morning, but M. de Fonvielle urged that a better plan would be to let the ascents be made at night, when less disturbing variations of temperature would be experienced. As manned balloons are sent up at the same time as free balloons, it was suggested that by making the ascents at night opportunity would be afforded of making astronomical observations which might be prevented at low levels by cloudiness. Another point which M.

de Fonvielle mentioned was that the ascents should not be made upon a particular day of the calendar month, as they are at present, but in the lunar month, by preference near the time of New Moon. The interference of moonlight with intended astronomical observations would thus be obviated.

DR. HERGESELL, president of the International Aëronautical Committee, has sent us an account of the preliminary results of the international balloon ascents of March 7. Twelve unmanned balloons, three manned balloons and one kite were sent up from various places on the Continent, but the records of three of the unmanned balloons were lost. At Vienna a height of 10,000 metres was reached; the lowest temperature recorded was −62° C. At Moscow the temperatures recorded were −13° C. at starting, −20° at 4400 metres, and −41°·6 at 6650 metres. At Trappes, near Paris, one balloon reached 10,820 metres and recorded −43°; the minimum temperature, −51°·2, was registered at 8792 metres. A second balloon registered −43°·6 at 10,481 metres and −53° at 8891 metres. At Strassburg a height of 10,000 metres was reached, and the minimum temperature recorded was −52°. Perhaps the most noteworthy record is that of a second balloon from Moscow, −12° at starting, −15° at 2700 metres; an inversion of temperature, +2°, occurred at an altitude of 250 metres.

THE *Scientific American* states that there is a project on foot for the construction of a movable electric platform on the right bank of the Seine. The platform will be underground, and its length will be about six miles. The route proposed passes under the Avenue de l'Opera, the great boulevards, Boulevard Sebastopol, the Rue Turbigo and the Rue de Rivoli. The new scheme calls for four platforms instead of three, as was in use at the Paris Exposition. The first platform will be stationary, the second will have a velocity of 1½ metres a second, the third 3 metres, and the fourth 5 metres. This will enable pedestrians to have a very rapid means of transit afoot in a portion of Paris which is greatly encumbered by vehicular traffic, for, as all the locomotion is in one direction, persons can walk very fast on the fourth platform, and will be able to cover a great distance. Some means of transit on the streets mentioned is so necessary that it is probable the scheme will be carried into effect.

THERE have been some discrepancies in recent allusions to the 1885 experiments carried out at Paris with the navigable balloon *La France*, Mr. Chanute, in the *Engineering Magazine*, April 1896, referring to speeds of 14 miles an hour, while Sir Hiram Maxim, in the *Aeronautical Journal*, October 1900, spoke of the speed as about 4 miles an hour, and only a single case of return to the point of departure. A note on this subject appears in the *Aeronautical Journal* for April, from which it appears that the balloon returned five times to its starting point. On referring to the original article in the *Comptes rendus* for 1886, we gather that the speed was estimated at from 4 to 6 metres per second, and probably the discrepancy was due to some confusion in regard to the units.

THE Botanical Exchange Club of the British Isles has just issued its annual report for 1899, from which we gather that the number of plants sent in shows a considerable falling off from the average of recent years. It is to be feared that the rival attractions of golf, photography and philately have diverted the attention of many who in former days devoted their spare time to the study of the British flora, and that modern facilities for attending science classes have hardly succeeded in maintaining the interest in field botany and natural history that was shown formerly. Still the report contains many records of interest, notably of the specific and varietal forms of the difficult genus Rubus, which have been studied by the Rev. W. Moyle Rogers, while Mr. F. Townsend has commented on the forms of Euphrasia. The distributor (Rev. W. R. Linton) calls attention to the desirability of members sending not less than ten specimens of each plant, but we question whether a too literal interpretation of this recommendation might not lead to the total uprooting of certain rarities.

ALTHOUGH it has long been known that no actual gas obeys Boyle's law, attention has been chiefly centred round the divergencies which occur at high pressures. It is true that the behaviour of gases at low pressures has received attention from Siljeström, van der Ven, Mendeléeff, Amagat, Fuchs, Krajewitsch, Baly and Ramsay and McLeod, and these experiments have led to the discovery of a discontinuity in the case of oxygen, but the experimental difficulties have led to considerable divergencies of results in other respects. An investigation is now described by Prof. A. Battelli in the *Nuovo Cimento* for January and February, which leads to the following results:—(1) Hydrogen obeys Boyle's law for pressures below one atmosphere down to about 0·2 mm.; (2) Air deviates slightly from the law between 2 and 5 mm.; (3) Oxygen exhibits a discontinuity about 0·7 mm.; (4) Carbonic anhydride at low pressures is compressed more than Boyle's law would indicate, probably owing to absorption by the walls of the containing vessel. With the exception of oxygen, and consequently air, the present investigation does not bring to light any anomalies not attributable to experimental conditions. On the other hand, the existence of discrepancies, representable by the introduction of a discontinuous function into the characteristic equation, is not incompatible with the kinetic theory, but may be attributable to changes in the grouping of the molecules.

THE Accumulator Industries Co. Ltd., has brought out a new primary cell, under the name of the "Cupron-Element," in which the electrodes are plates of zinc and copper oxide and the electrolyte caustic soda, or, for special purposes, caustic potash. The E.M.F. of this combination is low, amounting to only about 0·85 volt; but this is compensated for by a low internal resistance. It is claimed that the difficulties hitherto met with in the manufacture of a suitable anode (copper oxide) plate have been overcome, and that a coherent and, at the same time, highly porous plate has been obtained which can easily be regenerated when exhausted by simple exposure to the air. The cell has the advantage that there is no local action when on open circuit. To judge from the discharge curves printed in the catalogue, the cell has a high capacity and is capable of giving continuously a steady current. Of course, a primary battery with zinc as the ultimate source of energy can never be really a cheap way of getting current; but one which gives little trouble, is easily recharged and gives a good steady current, has a considerable range of utility, especially as a means of charging small accumulators.

TO the March number of the *American Naturalist* Dr. W. H. Dall contributes an account of the morphology of the hinge-teeth of bivalve molluscs, in which the various systems of nomenclature for these structures that have been from time to time proposed are discussed and contrasted. Many problems in connection with the homology and evolution of these structures still await solution.

IN another paper in the *American Naturalist* for March Messrs. Wheeler and Long discuss the males of certain species of ants of the genus Eciton, with figures of several. These ants have the habit of seizing the larvæ and pupæ of other kinds of ants, as well as insects of other descriptions, and storing them up in their nests to serve for food as occasion requires. When the colony removes to another nest the booty is carried with the other *impedimenta*. And if Eciton ants be fed with termites

or the larvæ of other species, many of these termites or larvæ will be carried about or stowed away in some corner of the nest for several days before being consumed.

WE are glad to learn, from its Report for the year 1900, that the Rugby School Natural History Society is in a flourishing condition and continues to make good progress. The requirements of its members render it essential that this body should not confine its investigations and its museum to local subjects, but it may be questioned whether a collection of Samoan ferns is entitled to form one of its exhibits. Two of the members of the Society are endeavouring to emulate Mr. Kearton in photographing the nests of birds in their natural situations, and, judging from the specimens published, may be congratulated on their efforts.

THE twentieth fasciculus of "Papers from the Harriman Alaska Expedition," now in course of publication in the *Proceedings* of the Washington Academy, deals with the nemertean worms, and is illustrated by an excellent coloured plate. During the summer of 1899 exceptionally favourable opportunities were enjoyed of collecting these worms on the Alaska coast south of Bering Sea, and the result has been to add very largely indeed to our knowledge of these organisms. Some thirty-two species were collected by the expedition, of which Dr. W. R. Coe describes no less than twenty-seven as previously unknown to science, while only two of the remainder had hitherto been recorded as denizens of the Pacific. No new generic types were found. For preserving these worms Dr. Coe reports that he found a solution of from two to five per cent. of formalin in sea-water gave satisfactory results so far as the preservation of external form is concerned, although it ruined the nerve and connective tissues.

IN the *Proceedings* of the Washington Academy of March 26 (vol. iii. pp. 111–138), Mr. G. S. Miller describes a collection of mammals made by Dr. W. L. Abbott in the Natuna Islands, lying between the Malay Peninsula and Borneo. Two collections of mammals from these islands have been previously described, the one by Messrs. Thomas and Hartert and the second by Mr. Thomas alone, the material having been obtained by Mr. A. Everett in 1893 and by Mr. E. Hose in the following year. The well-known energy of Dr. Abbott has added largely to the number of species obtained by these collectors, and Mr. Miller describes many of the acquisitions as new, among them being two species of chevrotain and a wild pig. With regard to a discussion that has taken place as to the relationships of the Natuna fauna, the present collection tends to show that there is a greater similarity between the mammals of the Malay Peninsula, Borneo and the intervening islands than has been hitherto supposed. Consequently there is little room for discussion as to whether the Natuna fauna comes nearer to that of the peninsula or of the large island.

IN its Report for the past year the Wellington College Natural Science Society directs attention to the efforts it has been making towards the revival of field work by the establishment of a field-club for the systematic investigation of the local fauna and flora within a twelve-mile radius. The project is worthy of all commendation as being the one important *raison d'être* of local natural history societies. And a special interest and importance attaches to such an investigation at the present time in the neighbourhood of the College. Six years ago the Society published local faunal lists compiled from the records of the previous twenty years. "During that time a great change came over the country just round the College; cultivation, drainage and building have all aided in destroying many plants and insects that used occasionally to be found; and these lists, although interesting as bearing record as to what did occur at one time or another, are now necessarily incomplete; many of the finds are no longer to be found, whilst other and new ones have to be added." It is much to be desired that investigations of a similar nature should be undertaken in other parts of the country where analogous changes have taken place.

PART 4 of vol. xiii. (March 1901) of the *Proceedings* of the Cotteswold Naturalists' Field Club contains an elaborate and well-illustrated memoir by Dr. S. S. Buckman on "homœomorphy" among Jurassic brachiopods. By homœomorphy the author understand "the phenomenon of species nearly alike so far as superficial appearance is concerned, but unlike when particular structural details are closely examined. It is the phenomenon of similarity in general with dissimilarity in details." Dr. Buckman's views are too complicated to discuss in this column, but it may be mentioned that, in his opinion, much confusion has arisen in the description of Jurassic brachiopods owing to failure in recognising the phenomenon in question. To the same publication the Rev. A. R. Winnington-Ingram contributes some notes on polydactylism in cats. The family to which he refers have a cross of the Manx breed, and the supernumerary digits are attributed to reversion to polydactylous ancestors intermediate between fishes and amphibians.

THE way in which the American Anthropological Museums are growing is a continual source of congratulation and at the same time of envy on our part and regret that there is such indifference to the science in Britain. To give one instance of the example set by our American friends, Dr. G. A. Dorsey informs us in *Science* (n. s., vol. xiii. p. 219) that in 1897 the Hopi collection of the Field Columbian Museum for Chicago was comprised within three cases. Thanks to Dr. Dorsey's representations, Mr. Stanley McCormick was induced to purchase for the Museum a very extensive collection formed by Mr. H. R. Voth, who has long been a missionary among the Hopi. Then, in order to render the exhibit exhaustive, Mr. McCormick, with characteristic American generosity, provided the funds for four expeditions which have very successfully investigated the archæology of the Hopi country, with the result that two halls in the Museum containing thirty-four cases are devoted to a demonstration of the ordinary everyday life of the Hopi and their past culture, and a third hall will shortly be filled. The most valuable exhibits are reproductions of nine of the underground altars, with their sand mosaics, which play so important a part in the great nine-day ceremonies of these interesting people. We have nothing in the whole British Empire to compare with this!

DR. THORODDSEN contributes to *Petermann's Mitteilungen* a paper on the earthquakes which occurred in Iceland in August and September 1896. In order to collect material for this report the author first addressed inquiries to a number of residents in the district affected—the southern lowland of Iceland—and in 1897 made an examination on the spot. Dr. Thoroddsen has been able to locate with considerable precision the region of greatest intensity of disturbance, and finds that, as in former cases, the chief centre of origin lay near the boundary between the subsiding lowland and the surrounding highland. The disturbance was, therefore, of tectonic origin; the volcanoes in the neighbourhood—Hekla, Katla and Eyjafjallajökull—remained passive during and after the earthquake shocks.

THE *Geographical Journal* for April contains an analysis of the physical geography of South America, by Col. G. E. Church. The paper, which is to form the introductory chapter of a book on the subject, gives a close comparison of the conditions in North and South America, and shows that "in general, man finds himself confronted by severe conditions in his struggle with

nature in South America. Thus far his efforts to develop and utilise its vast resources have made its commercial history an epic. The thought naturally presents itself that had North America fallen to the lot of the Latin race in the European occupation of the New World, and South America to the Anglo-Saxon, the former might still have maintained its old premacy; for the more rapid progress of the latter may not be due so much to racial superiority as to advantageous geographical urroundings."

THE list of additions to the library of the Royal Gardens, Kew, received during last year, occupies eighty-three pages in the *Kew Bulletin* (Appendix ii. 1901) just issued. The titles are printed on one side of the page only, so as to allow the list to be cut up and the slips used by persons and institutions having catalogues based on the Kew catalogue.

ANNOUNCEMENT has just been made by a committee of American anthropologists, of which Mr. F. W. Hodge, managing editor of the *American Anthropologist*, is secretary, of the proposed publication of an illustrated volume containing more than hirty folk-tales which were collected and translated by the late Frank Hamilton Cushing during his long and intimate association with the Zuñi Indian tribe of New Mexico. Information and subscription forms may be obtained from the secretary, whose address is Washington, D.C., U.S.A.

THE third divisional volume has been received of Thompson's "Gardener's Assistant," a new edition of which, edited by Mr. William Watson, assistant curator at the Royal Gardens, Kew, is in course of publication by the Gresham Publishing Company. Among the subjects dealt with are popular garden plants, greenhouse and conservatory, greenhouse plants, stove plants, orchids, indoor and hardy ferns, succulent plants, hardy shrubs, bedding and floral decorations. Several plates and numerous excellent illustrations accompany the descriptive text.

A LARGE terrestrial globe is an essential piece of furniture for the satisfactory teaching of geography. The ideal globe is in relief, but the price at which such a globe can be well produced s prohibitive to its extensive use. A large globe in which physical features are given prominence is the next best substitute, and this has been produced by Messrs. Philip and Son under the title of "Philip's Physical School Globe." The diameter is nineteen inches, and three forms of mounting of the globe are constructed, namely, one a pedestal for table, another the same with the addition of a graduated half meridian, and the third a tripod stand, with complete meridian and horizon.

THE following prices obtained for some of the natural history books from the library of the late Mr. P. Crowley, sold by Mr. J. C. Stevens at his auction rooms on Monday, are of interest:—"Transactions of the Entomological Society," complete set, 46 vols., 38*l.*; "Catalogue of the Birds in the British Museum," vols. 1 to 27, 1874-95, 48*l.*; "The Ibis," 1859 to 1900, with indexes, 42 vols., 75*l.*; "Proceedings of the Zoological Society," 1830 to 1900, 60 vols., 60*l.*; "The Birds of the British Islands," by Lord Lilford, 7 vols., 63*l.*; "Biologia Centrali Americana," 35 vols., 90*l.*; "Birds of Europe," by H. E. Dresser, vols 1 to 8, 1871-1881, vol. 9 supplement, 1895-6, 56*l.*; "Histoire Physique, Naturelle et Politique de Madagascar," by A. Grandidier, 1875-95, 35*l.*; "The Birds of Asia," by John Gould, 7 vols., 1850-1883, 51*l.*; "The Birds of New Guinea, Papuan Islands and Australia," by J. Gould, 5 vols., 1875-78, 45*l.*; "The Birds of Great Britain," by John Gould, 5 vols., 1863, 49*l.*; "Monograph of the Pheasants," by D. G. Elliot, 2 vols., 1872, 53*l.*; "Rough Notes on the Birds observed during Twenty-five Years' Shooting and Collecting in the British Islands," by E. T. Booth, 3 vols., 1881-7, 25*l.*

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. C. L. Lane; a Mozambique Monkey (*Cercopithecus pygerythrus*) from East Africa, presented by Miss Leah Simmons; a Rufous-necked Scimitar Babbler (*Pomatorhinus ruficollis*), a Golden-backed Woodpecker (*Brachypternus aurantius*) from India, presented by Mr. E. W. Harper; an Indian Python (*Python molurus*) from India, presented by Mr. C. Oscar Gridley; a Chameleon (*Chamaeleon vulgaris*) from North Africa, presented by Mr. C. King; ten Indian Cobras (*Naia tripudians*) from India, ten Reeve's Terrapins (*Damonia reevesi*) from China, ten Roofed Terrapins (*Kachuga tectum*) from British India, ten Blue Lizards (*Gerrhonotus coeruleus*), six Red Newts (*Sperlepes rubra*) from North America, a Red-fronted Lemur (*Lemur rufifrons*) from Madagascar, deposited; an English Wild Cow (*Bos taurus*), a Bactrian Camel (*Camelus bactrianus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

NOVA PERSEI.—*Bulletin* No. 16 of the Yerkes Observatory contains a report from Prof. Hale on the work done in connection with the new star in Perseus. An examination of the Nova with the 40-inch refractor on February 24 failed to show any trace of nebulosity. Photographs of the spectrum were obtained on eight nights, using Erythro plates, with spectrographs of one and three prisms respectively. These extend from H_α in the red to the ultra-violet H_ϵ; comparison spectra were taken of titanium, hydrogen and sodium. Photographs of the region of the Nova have been obtained with the 40-inch telescope, and will be subsequently measured at Columbia College Observatory. The brightness of the star has been measured by the wedge photometer.

A REMARKABLE GROUP OF NEBULOUS SPOTS.—Prof. Max Wolf, of Heidelburg, writes to the *Astronomische Nachrichten* (Bd. 155, No. 3704), describing an appearance of small nebulous bodies surrounding the star

$$\left.\begin{array}{rl} \text{R.A.} = & \text{h. m.} \\ & 12\ 52{\cdot}6 \\ \text{Decl.} = & +28^\circ\ 42' \end{array}\right\} (1855{\cdot}0).$$

They are so close together as to form a remarkable feature in the field of view. He was able to count 108 in a circle about 30′ of arc in diameter. Some of the fourth or fifth magnitude showed a central condensation, more or less elongated, while other fainter ones had a roundish form.

STONYHURST COLLEGE OBSERVATORY.—The annual summary of the meteorological, magnetical and other observations made at the Stonyhurst Observatory in Lancashire has just been issued by the director, Father Sidgreaves. Special co-operation with the International Meteorological Committee has been in force since November, observations of clouds and wind being made throughout three successive days of each month; on the second of these days balloon ascents are made by representatives of the Committee.

The work of comparison between individual sun-spots and terrestrial magnetic storms has been concluded and published in the *Memoirs* of the Royal Astronomical Society. This covers the period of eighteen years from January 1881 to December 1898.

Experiments are in progress in connection with the improvement of the present means of obtaining stellar spectra, quartz lenses being now employed, so that more of the ultra-violet region will be photographed.

CATALOGUE OF DOUBLE STARS.—Vol. i. of the *Publications* of the Yerkes Observatory consists of a general catalogue of 1290 double stars, discovered from 1871-1899 by Prof. S. W. Burnham. The stars are arranged in order of their right ascensions, full particulars being given of all the micrometrical measures of each pair. The work has been done with telescopes varying from 6 inches to 40 inches in aperture, the greater number (451) of the discoveries having been made with the smallest instrument.

INDIAN FORESTRY.[1]

BEFORE retiring from the Indian Forest Service the author obtained the sanction of Government to the publication of this volume, which contains a brief description of the forests and a sketch of the introduction and growth of forestry in the British Indian Empire. In the preface he says: "My career in the Indian Forest Service has extended over thirty-three years, and though I was not in the country when regular forest conservancy was first introduced, I arrived when it was still quite a small sapling, and I have seen it grow to the mighty tree it is at present, under the wide-spreading shadow of which I have grown old."

Mr. Ribbentrop is one of the two young German forest officers whom the writer of these lines in 1866 was permitted to engage for the Indian Forest Service. He came from Hanover, where he had received his professional training, and had worked under the late Forst-director Burckhardt, one of the most eminent foresters of his day in Germany. The other was Dr. W. Schlich, now principal professor of forestry at Coopers Hill, whose excellent "Manual of Forestry" has repeatedly been discussed in these columns.[2]

Obviously it is out of the question, within the space here available, to follow the author through his description of the forests and through his account of the earlier stages of forest administration in India; it must suffice, briefly, to state a few of the principal results accomplished and to indicate the lines on which, in the interest of the 294 millions inhabiting the large British Indian Empire, further progress in this business ought to be made. As it will be satisfactory to deal with the last figures available, those for 1898–99 will, in a few cases, be quoted, the book giving only those to the end of 1897–98.

In 1899 the area of reserved Government forests in the different British provinces of India aggregated 84,148 square miles, or 54,000,000 acres, more than the total area of England and Ireland together. The State forests of the German Empire only aggregate 16,400 square miles. These are very large figures, but the British Indian Empire is a very large country. Of the total area of the German Empire the State forests occupy 8 and in the British provinces of India the Government reserved forests occupy 8·6 per cent. of the total area. At first sight this seems a most satisfactory result; the Indian State forests constitute a slightly higher percentage than those of the German Empire, a country where the necessity of good forest management is acknowledged to the fullest extent. Besides the 16,400 square miles of State forests, however, there are large areas of Crown forests, of forests belonging to public corporations, there are, further, 8400 square miles of communal and 26,000 square miles of private forests. All these, excepting a small proportion of the private forests, are managed as efficiently as the State forests. The Governments in the different States have shown the way, they have taken the lead in the management of their forest domains, and the other proprietors have gradually followed suit. The total forest area of the German Empire amounts to 54,000 square miles, or 26 per cent. of the entire area. Sixty years ago Germany was an important timber exporting country, since then, as a necessary consequence of the development of industries and manufactures, and the increase of wealth, the imports have gradually exceeded the exports. Now it is only second to Great Britain in the list of timber importing countries, and this is so, although the annual production of wood per annum is increasing steadily, as the result of the great progress made in forest management. The total annual production of timber and firewood of the German forests is estimated at 38,000,000 tons, and this is supplemented by an import of 4,600,000 tons. The material progress of the country would not be possible had it not the large home production to fall back upon. There are other forest lands in India which are nominally under the control of the Forest Department, viz. 8800 square miles of protected and 27,700 square miles of unclassed forests, but in these areas protection is nominal, and they are not managed with a view to a sustained yield. The reserved forests are the only trustworthy resource for the future, and these, as stated, only form 8·6 per cent. of the total area. One of the excellent maps appended to the book illustrates the distribution of these forests in the different parts of the Empire, and this map shows at a glance the very unequal distribution. Berar has 23, the Central Provinces have 22, Burma has 9, but the North-West Provinces and Oudh have only 3·6 and the Punjab only 2 per cent. of Government reserved forests.

Nevertheless, it is an important point gained that so large an area is at the disposal of Government and that it is managed, so far as circumstances permit, with the view of obtaining from it a sustained and, if possible, steadily increasing yield of timber and other forest produce. The reader will ask the question whether it is right to lock up so large an area and to prevent the extension of cultivation, the establishment of fields within that area, in a country the population of which is mainly agricultural and is increasing steadily, which, indeed, is increasing with alarming rapidity in some districts and provinces.

What, then, has been the object in constituting this large area of reserved forest, and what is the object in maintaining it under forest? The author holds that the old records of Indian history, down to the invasion of the Punjab by Alexander the Great, prove that in those days extensive forests existed, and that the wholesale destruction of these forests has had the most deteriorating effect on the climate. He does not go so far as to maintain that by afforestation of large tracts the climate might be improved to such an extent as to stop the recurrence of these terrible seasons of drought, which are one of the chief difficulties with which the Government of India has to deal. It is evident, however, that his thoughts run in this direction. Doubtless it is not safe to lay stress upon such arguments. We may readily assent to the words of the author: "In a warm climate the denudation of a country diminishes its moisture and consequently its fertility" without indulging in the hope that in seasons of drought the presence of forests will increase the rainfall.

The local influence, however, of well-stocked forests in India no intelligent person, who knows the country, will deny. Well-stocked forests afford shelter to fields, to man and beast against the scorching winds of the hot season, and the dew is heavier in their vicinity. Of much greater importance still is the effect of well-stocked forests in regulating the surface drainage, in maintaining an even water supply in springs and streams, in preventing the denudation of hillsides, the silting up of rivers, and the destruction of fields and gardens in the plains by the sand and silt washed down from the hills. The author quotes a description of the Ratnagiri district on the western coast of the Peninsula, south of Bombay:—"Under a rainfall between 100 and 150 inches a year, this district is almost bare to the crest of the ghats, the result of fires, grazing and shifting cultivation. The four principal streams, which, rising in the Ghat Mountains, run a short course to the sea, were all navigable formerly, and were important for the trade of the country. Small boats still run, but the streams are gradually silting up, because the hills at their headwaters have become denuded."

In the Hoshiarpur district of the Punjab the Siwalik range of hills stretches from the Bias to the Sutlej river in a south-easterly direction. These hills consist of a very soft friable sandstone, alternating with strata of loam and clay. Formerly these hills were fairly well wooded. In 1846 they became British territory; the consequence was a rapid increase of population, a great demand for wood and charcoal in the fertile plains below, and the influx of a floating population of graziers with large herds of cattle. The result was complete denudation of these hills; the loose soil, no longer protected by vegetation, was washed down, broad rivers of sand spread into the plains below, and the end has been that fields and gardens of 940 villages, once prosperous, are now covered with sand, which has laid waste upwards of 70,000 acres of fertile lands. This district, rich formerly, is now traversed by numerous broad parallel sandy belts, cut out of the fertile and crop-bearing area.

Efficient protection of the reserved forests was only commenced a comparatively short time ago, and yet the author is able to state numerous instances from different parts of the country, in which protection has completely changed the character of the torrents and streams taking their rise in the forests. After rain, the water no longer rushes down, carrying sand and silt with it; the channels have been confined into permanent beds; they have become narrower and deeper, and the old beds to the edge of the channel have become stocked with grass and thousands of seedlings. The regulation of the underground waterflow takes more time, but Mr. Ribbentrop is able to report a case where, near a protected reserve in Ajmere, water is now found at the depth of 15 feet, where formerly it was not

[1] "Forestry in British India." By Berthold Ribbentrop, C.I.E., late Inspector-General of Forests to the Government of India. Pp. ii + 245, with 4 maps. (Calcutta: Office of the Superintendent of Government Printing, India, 1900). Price 4s. 6d.

[2] NATURE, vol. xli. p. 121; vol. xliv. p. 265; vol. liii. pp. 510, 535.

reached under 25 feet. The denser vegetation, which is the result of efficient protection, has everywhere counteracted erosion, has prevented landslips and sudden floods.

These indirect advantages of forest conservancy are obvious and of very great importance, but in most cases the chief object aimed at has been the production of timber, bamboos, firewood and other forest produce. The produce yielded by the forests furnishes the revenue, which enables Government to maintain a proper management of these estates. In old times the requirements in wood and timber of the people and of Government were met without difficulty. But with the increase of population, the growing wealth of the people, the construction of railways and other public works, the demands upon the forests increased. Within reach of the railways and elsewhere, forests disappeared with incredible rapidity. The threatening scarcity of timber and wood compelled the Government to take action. The author gives an interesting account of the efforts made in the beginning of last century on the western coast to provide a permanent supply of teak timber for ship-building, efforts which failed completely, because most injudicious and unjust attempts were made to interfere with private property. In the same way the history of the Tenasserim forests is told, the conservancy of which was urged by Dr. Wallich in 1827, and which were gradually, but effectively, destroyed through a series of mistaken measures. In the adjoining province of Pegu, at the command of Lord Dalhousie, and under the guidance of Sir Arthur, then Major, Phayre, in 1856, a systematic management of the teak forests was introduced, ensuring the certainty of a permanently sustained yield of teak timber, while the friendly co-operation in the business of the Karen and Burmese inhabitants of the forests was secured, by giving them profitable and permanent employment in forest work. When, after five years of hard work, a steadily increasing surplus revenue from the forests had been realised, proving beyond question the great value of those domains, the timber merchants of Rangoon, naturally anxious to get this valuable property into their hands, had prevailed upon the Government of India to grant their request, and accordingly in February 1861, orders were issued to the Commissioner of Pegu to throw open the forests to private enterprise. These orders, which were praised as most enlightened and liberal by Anglo-Indian public opinion, seemed at the time to put a stop to all progress in this direction. Fortunately, at a later date, the greed of the permit-holders under the new arrangements, resulted in breaches on a large scale of the terms of their permits, the consequence of which was, that the permits were cancelled.

Not more steady was the progress made in other provinces in attempting to place the management of the forests in such a position as to enable them to furnish the needful sustained yield of wood and timber. When Sir John (afterwards Lord) Lawrence landed at Calcutta in January, 1864, as Governor-General, he had determined to stamp out this new-fangled scheme of forest administration, which would weaken the position of the chief civil district officer by taking away from him the charge of the forests. It was only through the fortunate accident that Sir Richard Strachey, at the time secretary to the Government of India in the Public Works Department, who had some time previous taken charge of the forest business, gradually gained influence over the Governor-General to such an extent, that actually in Sir John Lawrence's reign the forest establishments under the Government of India were placed on a regular organisation.

Apart from reckless cutting, the improvement of the forests was impeded by two old-established practices, grazing and the jungle fires of the hot season. Two important and interesting chapters are devoted to these subjects, to the efforts made to regulate grazing and to protect the forests against fire. Here it must suffice to state that systematic fire protection was commenced in the Central Provinces in the hot season of 1865. Colonel Pearson, then Conservator of Forests in that province, had serious doubts on the subject; he knew that any attempt to interfere with this ancient institution, which cleared the ground of inconvenient grass and underwood, would be distasteful to all, Europeans as well as natives. With the powerful support of Sir Richard Temple, then Chief Commissioner of the Central Provinces, he made the attempt. He selected the Bori forest in the Satpura range, a district most favourably situated for the experiment. He succeeded, and within a few years he saw the condition of the forest entirely altered. The extensive grasslands and smaller blanks in the forest gradually filled up from the edge with coppice shoots and self-sown seedlings, the soil, which hitherto had been hardened and sterilised by the annual fires became fertile, the trees increased rapidly in height and girth, and the fresh shoots of the bamboo became taller and stouter. Gradually this difficult work was taken in hand in all provinces, and in 1899 no less than 29,492 square miles were successfully protected against fire, or one-third of the total area of reserved forests. The expense of these operations latterly has been between ten and eleven rupees per square mile.

The question will now properly be asked: Who pays for all this business? Forest revenue and expenditure have increased steadily ever since forest business was properly organised. In 1898–99 the results were as follows:

Revenue	...	Rs. 1,90,38,520, or	1,270,000*l.*
Expenditure	...	,, 1,00,33,920, ,,	670,000*l.*
Surplus	...	,, 90,04,600, ,,	600,000*l.*

This, it is true, is only a small contribution to the annual revenues of the British Indian Empire, which in the same year amounted to 1,01,40,00,000 rupees. But it is something, and the surplus is increasing steadily. Certainly it must increase, for at present it only amounts to 2·7*d.* an acre. In some provinces, fortunately, the surplus is higher. Since the annexation of the kingdom of Burma the reserved forests in this province are:

7,679	square miles in Lower Burma.
7,988	,, ,, in Upper Burma.
Total 15,667	square miles.

Both in Upper as well as Lower Burma teak timber is the principal and most valuable produce of the forests. The teak forests of Upper Burma had been leased by the King to powerful firms at Rangoon under the vaguest conditions. The lessees were only liable to the payment of a lump sum per annum, without reference to the amount cut by them. Under these conditions the utter devastation of the forests within a short time was inevitable. It has been Mr. Ribbentrop's privilege, after the conquest of the country in 1886, to induce the Government to claim the right of interference, and it is entirely due to the tact and determination with which he conducted the negotiations that a settlement was arrived at, under which no trees can be cut that have not been selected and girdled by the Forest Department. Thus this valuable property was saved from ruin, and it is satisfactory that the last of the leases will shortly expire. The surplus realised by the Burma Forests in 1899 was 59,24,000 rupees, corresponding to 13*d.* an acre. This is better than the amount realised from the whole reserved forests of the British Indian Empire. But even this is a poor result as compared with the yield of properly managed forests in Europe. Of all States of the German Empire, Prussia has, owing to unfavourable soil and climate, the least productive forests, and the average net yield of the State forests is only five shillings an acre, while the State forests of Saxony yield twenty and many forest ranges in that country yield thirty to forty shillings an acre. Much progress, therefore, has still to be made in improving the condition and productiveness of the Indian forests before they can hold their own in comparison with the forests of Europe. This result, however, will be attained provided a sound and vigorous forest policy is continued.

Besides timber, wood and bamboos there are numerous other substances, such as tanning materials, gums and caoutchouc, necessary for the every-day life of the people and required for the commerce of the world, which are produced and will be produced on a much larger scale, provided the forests are efficiently protected and properly managed. From all this a growing surplus revenue may be obtained. There is, however, a class of forest produce more important than all these for the welfare of the country, which cannot be expected to contribute very largely to the surplus forest revenue. This is grass and cattle fodder.

In a hot climate, except in districts with an exceedingly heavy rainfall, a better crop of grass is produced under the shade of trees than in the open, and this is particularly the case in seasons of drought, to which, unfortunately, large portions of India frequently are subject. In the dry climate of Rajputana numerous chiefs and princes had from time immemorial established game-preserves, chiefly as cover for pigs. The forest growth in these preserves was carefully protected, and during the terrible famine

which devastated that country in 1867, 1868 and 1869, they furnished an abundance of grass and branches of trees to feed the cattle of the neighbouring towns and villages. Two small British districts, Ajmere and Merwara, are situated in the midst of these native States of Rajputana. Here the whole of the waste and forest lands at the disposal of Government had, at the settlement of 1850, been handed over to the villagers, the State relinquishing its rights in these lands. The results of this "liberal" policy had been disastrous. The hills had become denuded, the timber was sold, the wood was used and these lands had become utterly barren and unproductive. For their crops the people of these districts almost entirely depend upon irrigation. The water is furnished by numerous ponds or tanks, formed by embankments thrown across valleys at convenient points. Many of these tanks are old, others have been built since the country came under British rule. The scanty rainfall in these districts does not come down continuously, but in a small number of heavy showers. The rain rushed down the denuded hillsides in torrents and, instead of filling the tanks slowly but steadily, burst the embankments or filled the tanks with the silt which the floods had brought down. These districts the writer visited in December 1869. The cattle had perished, the people had fled, large villages were entirely deserted, and the country was almost depopulated by these years of drought and famine. Adjoining the district of Merwara on the east side is the territory of the Thakur of Bednor, a feudatory to the Maharajah of Udaipur, and the contrast was extremely surprising—in British territory the hills denuded, in Bednor the hills wooded, the forest having been carefully protected. From the top of Bairat Hill, on January 2, 1870, we looked down upon the town, with its large tank and beautiful groves of fruit trees, and here the Thakur's eldest son, who had the management of the forest lands, told the writer how the Nasirabad charcoal contractors had come, offering large sums if he would allow them to cut. He had refused and would always refuse their request, knowing well that the grass in the forest and the branches of the trees had saved the cattle of Bednor in seasons of drought, and that the water supply in the tanks, upon which the fertility of the country depended, was maintained by the forest growth on the hills.

After several years' hesitation, action was at last taken, in 1874, to remedy the mistakes which, with the best intentions, had been made in 1850. The Ajmere Forest regulation was passed, which gave the Chief Commissioner of those districts power to take up any tract of waste or hilly land as a State forest, granting the people who had formerly had an interest in that land the right of cutting grass and wood in it for their own requirements and a liberal share in the net proceeds from the management of these lands. This measure, at first sight, might be termed a confiscation of rights deliberately granted. In reality, however, the proprietary rights had at the settlement not been granted to individuals, but to the village communities. They were communal lands, and as such public, not private, property. Government, therefore, as the guardian of all public interests, had the duty to interfere. This small measure, had it been properly followed up, might have been one of the most beneficial measures passed in the reign of Lord Northbrook. Unfortunately, only 139 square miles, or 5 per cent. of the total area, have been demarcated as State forest in Ajmere-Merwara. And worse than this, grazing was frequently allowed without real necessity, and consequently protection remained incomplete. Nevertheless, with all these drawbacks these reserves are now very fairly stocked with trees and shrubs, and they have proved a great protection to these districts in times of drought during the last twenty years.

In the famine, which affected a large portion of the Bombay Presidency in consequence of the short monsoon of 1896, operations were undertaken on a large scale to provide cattle fodder from the forests to all districts which needed such help. Mr. Allan Shuttleworth, the Conservator of Forests, organised and directed these operations. Presses were set up near the forests, roads were constructed, hay was made and pressed in 80 lb. bales, which were despatched by train, and were sold at cost price at depots all over the affected districts. The same plan was pursued in the late famine, and has also been adopted in other provinces. Grain can easily be sent to districts affected by scarcity, the provision of cattle fodder is more difficult, and in previous famines the loss of cattle has always been the chief calamity. When at last rain falls and no cattle are left to plough, the distress is terrible. Millions of cattle have been saved by these measures, and it is to be hoped that the ruling authorities in India will always bear in mind that if in seasons of drought the forests are to be in a position to furnish cattle fodder on a large scale, they must in ordinary years be efficiently protected against fire and must not be indiscriminately opened to cattle.

Besides the areas which are classed as forests, there is in each province a large extent of waste, aggregating upwards of 380,000 square miles, or considerably more than one-third of the entire area of the British provinces. At present these waste lands furnish wretched pasture, the scrub and isolated trees upon them yield fuel, and, on a small scale, wood for building and agricultural implements. One of the most important, but at the same time most difficult, tasks awaiting Indian foresters in the future is to undertake the management of these lands. On a small scale something in this direction has been done by the formation of canal plantations, and the establishment of fuel and fodder reserves in a few districts. But the work must be taken in hand on a much larger scale and on a methodical system in all provinces. Under good management these lands will produce heavier crops of firewood and cattle-fodder. At present manure is used as fuel in most districts, and the result is, in spite of the skill and industry with which the Indian peasant cultivates his land, an exceedingly poor yield of crops. In his report on the improvement of Indian agriculture, Dr. Voelcker justly urges the establishment on a large scale of fuel and fodder reserves, in order to supply wood to take the place of cow-dung as fuel. "If wood," he says, "could be made to take the place of dung for fuel, we should soon come to realise that more wood means more manure, that more manure means heavier crops and an increasing fertility of the soil."

It is not impossible that these measures may eventually lead to the formation of village forests. Experience has shown in Germany, in France and in other countries of Europe, that municipal self-government of towns and villages develops in a healthy manner where these municipalities have landed property, provided it is well and efficiently managed. The communal forests in these countries contribute largely to the prosperity of the agricultural population. They furnish all the wood and timber the villages require, and the sale of the surplus yields a steady annual income, in many cases sufficient to cover the charges of the municipality for roads, schools, churches and other purposes.

In a number of interesting chapters the author explains the nature and extent of the rights which Government possessed in the waste and forest land of the different provinces at the time that the State forest reserves commenced to be established. The British Government had legally succeeded to the rights actually exercised by the former rulers of conquered or ceded States at the time of conquest or cession. Consequently, the unoccupied waste, including forests, as a rule, was the property of the State. In these waste and forest lands, however, the people had grazed their cattle, had cut wood and bamboos for their use, and had cleared land for shifting or permanent cultivation. Under the former native Governments the forests had thus been used by the people, not as of right, but subject to the good pleasure of the ruler. When the preparation of proper forest laws for the different provinces was considered, between 1869 and 1878, the most important question was, to what extent this long-continued user of the Government forests should be regarded as constituting a prescriptive right; and it was deliberately settled that the customary user of the forests under British rule must be held to constitute a prescriptive right. On the other hand, it was acknowledged that Government, as the guardian of all public interests, must insist upon the regulation of these rights, so as to render possible a good management of the reserved forests in the interests of the country.

It was held that the growth of forest rights in India had been analogous to the growth of similar rights of user in Europe, and consequently that the legal provisions for regulating them or, in case of need, for extinguishing them by means of suitable compensation, must be analogous to forest laws made in Europe.

By the Indian Forest Acts the duty of deciding which claims shall be admitted as a right, as well as the regulation and commutation of rights thus admitted, is entrusted to special officers, styled forest settlement officers, and an appeal from their decisions is provided. Under the procedure prescribed by these acts, the 84,148 square miles of reserved forests have been settled. In many cases was it possible to extinguish the rights by suitable compensation; in others the forest remained burdened with rights to pasture or the cutting of wood, but these

rights were strictly defined in regard to area, the number and description of cattle admitted to graze, and the amount of timber to be cut. In many instances the settlement officers have gone far beyond the requirements of the law; they have often been disposed to place heavy burdens upon the Government forests, in order to make matters as comfortable as possible to the people in the vicinity. Especially in regard to pasture, the tendency of most Governments in India has been to insist on cattle being admitted to graze in the forests far in excess of what was prescribed by the forest settlement. Young forest growth cannot come up under heavy grazing. In seasons of drought, as a matter of course, the forests must be, and are, always thrown open. But if this is done in ordinary seasons, the forests cannot improve, and cannot provide what is wanted in times of scarcity.

In these circumstances agitation against forest administration is of frequent occurrence. In his delightful and most important work, "Forty-one Years in India," vol. i. pp. 441, 442, Lord Roberts states: "Amongst the causes which have produced discontent of late years I would mention our forest laws and sanitary regulations, our legislative and fiscal systems—measures so necessary that no one interested in the prosperity of India could cavil at their introduction, but which are so absolutely foreign to native ideas that it is essential they should be applied with the utmost gentleness and circumspection. . . . . The proceedings and regulations of the Forest Department, desirable as they may be from a financial and agricultural point of view, have provoked very great irritation in many parts of India. People who have been accustomed from time immemorial to pick up sticks and graze their cattle on forest lands cannot understand why they should now be forbidden to do so, nor can they realise the necessity for preserving the trees from the chance of being destroyed by fire, a risk to which they were frequently exposed from the native custom of making use of their shelter while cooking, and of burning the undergrowth to enrich the grazing."

In these words Field-Marshal Lord Roberts faithfully expresses the views of many leading public men in India. And yet the development of the British Indian Empire, through railways and telegraphs, through extended irrigation, the steadily growing wealth of its inhabitants, necessitates the maintenance and improvement of its forests, while the persistent growth of the population, in spite of famines, cholera and plague, demands that the large areas of waste lands should produce more cattle-fodder and more firewood. These are demands which cannot be resisted.

A detailed account is given of the Dehra Dun Forest School, which was established in 1878 for the professional training of native forest officers. Of the first director of that institution, Captain (now Colonel) F. Bailey, R.E., the author justly states that it was entirely owing to his exceptional powers of organisation, energy and ability that the new institution took healthy root from the outset. It has been explained at the outset of this article that in 1866 two young forest officers from Germany, Dr. Schlich and Mr. Ribbentrop, were engaged for the Indian forest service. In the same year arrangements were made for the professional training of young Englishmen in the State forests of France and Germany. The first selection was made in 1867, and the first men trained under this system joined their province in 1869. Since then a varying number has been sent out annually. In 1887, after the arrangements in France and Germany had come to an end, the first men arrived, who had been trained under existing arrangements at Coopers Hill. Altogether, until 1899, 207 professionally trained men have gone out, of whom in that year 152 were still in the Indian Forest Service. This number obviously is wholly insufficient to provide for the management of 84,000 square miles of reserved forests. Moreover, the small surplus revenue yielded by these forests would make it out of the question to employ English officers for their management. In the State forests of the kingdom of Saxony, the mean area of a forest range or executive charge is 4000 acres. The executive officer, here styled Oberförster, receives the same professional training, and has the same social standing, as the higher forest officers to whom he is subordinate. Every member of the superior Forest Service begins his career as assistant to the Oberförster, and his first appointment to a responsible post is that of executive officer. This organisation ensures efficiency, because the Oberförster has a reasonable chance, by distinguished service, of rising to the highest appointments in the department.

An organisation as simple and effective as this is impossible in India. The revenue of the forests is too small. Further, the officers must necessarily belong to two classes, expensive Englishmen for the higher appointments, and natives at lower rates of pay for the executive charges, and these two classes cannot be amalgamated. Four thousand acres in Saxony yield a net revenue of 4,000*l.* at 20*s.* an acre; the area required to produce a similar revenue in India would be so large as to be quite unmanageable for one executive officer. Thirty square miles, or 19,200 acres, would be a large but still manageable area in India. From 1888 to 1899 the surplus has doubled, and it is not unreasonable to expect that in 1910 it will amount to 6*d.* an acre. At that rate 30 square miles would yield an annual surplus of 480*l.* By that time there ought, therefore, to be 2800 professionally trained forest officers for the executive charge of these forest ranges. The actual number of forest rangers in the different provinces at present (July 1, 1900) is 425. The organisation, therefore, of executive charges is far from complete. To a great extent the executive management of these estates is at present in the hands of the superior controlling and directing officers, who do the work through the agency of forest guards and other protective officers, men who have received no professional training.

The chief difficulty at present is, that the men who enter the Dehra Dun Forest School belong to a lower social stratum than is desirable. And this will continue until means are found to give forest rangers reasonable prospects of promotion. Something in this direction has been done by establishing a provincial branch of the superior Forest Service, so that from time to time a few really distinguished forest rangers may be promoted. And when the advantage of relying mainly upon native agency in forest business has been fully recognised, means doubtless will be found to improve the prospects of advancement for native forest rangers. No possible political difficulty can arise through employing natives of India in the higher branches of the forest service, and hence it seems right to use this department to make the experiment.

Sir Thomas Munro, one of the most distinguished Indian statesmen in the early part of last century, while Governor of the Madras Presidency, wrote as follows on December 31, 1824: "All offices that can be held by natives without danger to our power might with advantage be left to them," and further on follow remarks to the following effect: "To improve the character of the natives we must open the road to wealth and honour and public employment." Since 1824 the British Indian Empire has not only increased enormously in extent and population, but good government, the security of persons and property, the impartial administration of justice, the growth of commerce and manufactures, irrigation works, roads, telegraphs, railways, and by no means least, schools and colleges, all this has brought about a tide of progress which cannot now be stemmed. But the blessings of progress will be valued more by the people if they are not all dispensed by the hand of the foreigner, if natives themselves are the agents, to a greater extent than is the case at present, in the undertakings which contribute to their well-being.

Mr. Ribbentrop is not an advocate of these plans, yet on several occasions he bears testimony to the excellent work done by natives of India, provided they have received a good professional training in surveying or forestry. A weighty objection is raised by parents in this country that plans like these will take the bread out of their sons' mouths. Latterly from six to eight men, who had received their professional training at Coopers Hill have been sent out annually. It may be regarded as certain that, if all goes well, the number required will increase largely, not only because the management is gradually becoming more intensive, improving the yield capacity of the forests and augmenting the revenue, but also because a constantly increasing number of Indian forest officers are required in native States and other countries, such as Siam, and in the British Colonies. Even should a few more appointments be filled up by the promotion of native forest rangers, the number of men required from Coopers Hill will not diminish but will increase. And surely it is better that a policy should be followed which will tend to place British rule in India upon a safe foundation than that a few more appointments should be available for young men at home. The beneficial effects of forestry will not be fully realised until it ceases to be an exotic plant. The educated natives of India must feel that they are the allies of the British Government, and this can only be brought about by giving them

a larger share in all works undertaken to promote the welfare of their country.

The author does not claim to be a botanist, nor does Dr. Schlich, who preceded Mr. Ribbentrop, nor does their successor, Mr. H. C. Hill, the present Inspector-General of Forests. It is necessary to mention this because in England, also among scientific men, the opinion prevails that forestry is a branch of botany, and that a forester who is not a botanist cannot claim to be a scientific man. Dr. Schlich's great merit while holding the appointment in India was to organise that branch of forestry which deals with the plans regulating the working of the forests, a business which is based more upon mathematics than upon botany. Mr. Ribbentrop's great achievement has been to study and correctly to appreciate the peculiar sylvicultural requirements of the great variety of trees and bamboos with which the forester has to deal in India. Through his labours the management of teak, of sal, sissoo, deodar, and of other important trees when growing by themselves or in company with other kinds or with bamboos, their regeneration, natural or artificial, and their subsequent treatment under different conditions of soil and climate, is much better understood now than it was twenty years ago. These are great results, which, provided no retrograde measures are adopted, will bear fruit in steadily increasing the productive powers and capital value of the forests, and will contribute largely to the welfare of the millions inhabiting the British Indian Empire.

DIETRICH BRANDIS.

SUBMARINE BOATS.

THE building of five submarine boats for the British Navy not only forms quite a new departure but also, perhaps, the advent of the nucleus for an instrument of war of novel design. The boats (says *Engineering*, March 29), which are being built by Messrs. Vickers, Sons and Maxim, Ltd., are of the *Holland* improved type and are 63 ft. 4 in. in length over all, 11 ft. 9 in. beam, and 120 tons displacement submerged, and they will be capable of expelling torpedoes either with the boat at rest, during the run on the surface, or steaming at any speed submerged. When running on the surface the boats will be propelled by a gasoline engine (of marine type, inverted, and with four single acting cylinders). The amount of fuel carried will suffice for a run of about 400 miles with a maximum speed of about 9 knots, and when submerged an electric motor of the waterproof type, worked with storage batteries, will give the vessel a speed of seven knots, which can be maintained for four hours. The general operation of the boat is given as follows:—"Before it is desired to make a dive, the boat is brought to 'awash' condition, with only the conning tower ports above the water. The dive is then made at a small angle until the proper depth is reached, when by automatic means the boat is brought to a horizontal position. After the discharge of the torpedo from the fixed bow tube, the compensation for the weight of the torpedo is made automatically, causing only a slight change of trim for a few seconds. Provision is made for quick rising and diving, the time of appearance of the conning tower above the water being dependent on the skill of the navigator." In the United States Navy the *Holland* has undergone most exacting trials and has proved herself "stable in service working," and it is here we get the most convincing testimony, where Admiral Hitchborn, chief constructor in the United States Navy, states in his official report, "The *Holland* has shown herself capable of such complete control in the vertical plane that she may be kept within a few inches of any desired depth while moving, or brought to the surface and taken under again in a very short time: her direction and control in the horizontal plane on the surface is effected with the same facility as any other craft, and submerged is limited only by the difficulties of vision: her crew are provided for on board with reasonable comfort and perfect safety for such periods as she may be in service and working either upon the surface or submerged; and her armament, consisting entirely of torpedoes, gives her great offensive power."

THE CURRENTS IN THE GULF OF ST. LAWRENCE.

IN a former article (January 24, 1901, p. 311) we gave a summary, from a pamphlet recently issued, on the currents in the Gulf of St. Lawrence, in which we noticed some points of general application to similar researches elsewhere. This pamphlet, issued by the Department of Marine and Fisheries, Canada, gives concisely the results of investigations in the summer seasons of three years in that Gulf, conducted by Mr. W. Bell Dawson, in charge of the Survey of Tides and Currents. It is primarily for the benefit of practical seamen; but it also contains an explanation of the hydrography of the Gulf, on which this Survey has thrown considerable light; and it is this part that we now summarise.

General Characteristics of the Gulf of St. Lawrence.—With the exception of the currents in the various straits and near the heads of the bays, the currents met with in the open Gulf seldom exceed one knot. They are, therefore, the more easily influenced by strong winds, especially at the surface of the water. Currents which have a greater speed than this are found in Belle Isle and Cabot Straits, in Northumberland Strait, off the Gapsé coast, in the Gut of Canso, and locally in channels between islands and at the mouths of rivers.

The water of the Gulf may be roughly divided by a line running from South-west Point of Anticosti to the middle of Cabot Strait. Along the south-western side of this line the water has a lower density, as it is apparently made a little fresher by the outflow of the St. Lawrence River. To the north-east of this line, throughout the north-eastern arm of the Gulf, the water has the same density as in the open Atlantic.

The general drift of this water of lower density is outward, towards the Atlantic. This gives rise to two constant currents, one at the mouth of the St. Lawrence along the Gaspé coast, which may be called the "Gaspé Current," and the other on the west side of Cabot Strait around Cape North, which may be called the "Cape Breton Current." A third constant current is found on the west side of Newfoundland, making north-eastward from the Bay of Islands towards Rich Point.

It is to be noted that in calling these currents constant it is only meant that they usually or most frequently run in the one direction. During certain winds they may be much disturbed, or their direction may even be reversed.

Temperature.—It appears that in general the temperature of the surface water merely rises with the progress of the season; and it is also natural that the water should become warmer to a greater depth as the season advances. Even this has its limitations, however; as at a depth of 50 fathoms no greater rise in temperature has yet been found than from 32° to 34°, between the month of June and the end of September.

At all three angles of the Gulf it was found that the coldest water forms a layer between the depths of 30 and 50 fathoms. In the vicinity of Belle Isle Strait, the same low temperatures are also found at these depths; although there the temperature towards the surface is relatively lower, as a rule, than in other regions. It is probable that this cold layer extends very generally over the Gulf area. Below this cold layer, in the deep channel of the Gulf, the temperature from 100 to 200 fathoms is found to range very constantly from 38° to 41°. This result was obtained in Cabot Strait, and also between the Gaspé coast and Anticosti, 220 miles further in from the Atlantic, along the deep channel. This deep channel runs into the Gulf from the Atlantic basin through Cabot Strait, and maintains a continuous depth of some 200 fathoms across the middle of the Gulf to the mouth of the St. Lawrence River. It still has a depth of 100 fathoms half-way up the estuary on the Lower St. Lawrence.

Density.—It may be stated broadly that throughout the north-eastern portion of the Gulf the average surface density ranges from 1·0235 to nearly 1·0245; while in the south-western portion the density is below 1·0235, ranging usually down to 1·0220, and falling in the Gaspé Current itself to 1·0210. The dividing line between these two portions of the Gulf runs approximately from South-west Point, Anticosti, to a point in the middle of Cabot Strait. The densities in the border region near this dividing line naturally vary to some extent. The density of the north-eastern portion is practically the same as in the open Atlantic, as it was there found to range from 1·0237 to 1·0242, as shown by seven determinations made at the end of June off the south and south-east coasts of Nova Scotia.

This result is important in showing that the lower densities found in the south-western portion of the Gulf of St. Lawrence are confined to that side; and this also accords with the conclusion that the general set or drift across the Gulf is in the direction of a line from Gaspé to Cape Breton. On the other hand, the endeavour to obtain some differences locally, which would correspond with the various directions of the current, was without result; although a large number of temperatures as well as densities were taken for this purpose.

The deep water as found from samples taken at depths of 100

and 150 fathoms, both in the vicinity of Gaspé and in Cabot Strait, ranges in density from 1·0254 to 1·0261. The density of this deep water is very interesting in affording an explanation for the otherwise anomalous fact that the colder water at 50 fathoms is found to float upon it. It also corresponds with the density at similar depths, off the coast of Nova Scotia.

Current across the Gulf area.—The general connection of the Gaspé and Cape Breton currents became evident when it was ascertained that the water of lower density kept to the south-western side of the Gulf. The observations of the current in open, and the reports from steamships, also accord with a general movement of the water towards the south-east, as this is the more usual direction, and the currents which are found at times to run across this prevailing direction are to be attributed to the influence of the tides and the wind.

As to the route taken by the water in traversing the Gulf from the Gaspé region to Cape Breton, it seems fair to conclude, from the evidence furnished by the density observations, that the greater proportion finds its way eastward between the Magdalen Islands and Prince Edward Island, while a certain amount may also pass north of the Magdalen Islands, on the line from Bird Rocks to St. Paul Island. It is probable, also, that some of the water may come from Northumberland Strait, as the water there is also low in its density.

For a discussion of the probable reasons why the water of lower density keeps to the south-western side of the Gulf, the Reports of the Tidal Survey may be referred to.

The St. Lawrence River in relation to the outflow from the Gulf.—It can hardly be doubted that the low density of the water in the Gaspé Current is to be attributed to the outflow of the St. Lawrence River; and we are thus able to trace the influence of this water as far as Cape Breton, where it finally mingles with the water of the Ocean. The volume discharged by the St. Lawrence has been measured at different seasons, and with the addition of the principal tributaries along its estuary, the total volume of fresh-water discharge would probably amount in all to 340,000 cubic feet per second. This volume of fresh water will mingle with sea water for which we may assume a density of 1·0240, as this may be taken to represent either the mean density of Atlantic coast water to a moderate depth, or the density of the salter water in the Gulf itself. Under these conditions, the fresh water of the St. Lawrence would be sufficient to furnish a stream of water reduced to the lower density of 1·0230 which would be twelve miles wide and 68 feet deep, and moving with a speed of one knot per hour. This would represent the average density of the Gaspé Current, and would probably be an approximation to its average speed and its volume; and such a comparison may therefore serve to illustrate the way in which the conditions may be accounted for, if the data themselves were more closely known.

It is to be noted, however, that as regards volume the St. Lawrence River is almost insignificant as compared with the outflow of the Gaspé Current. This current, whether it flows near the coast or in the middle of the passage between Gaspé and Anticosti, has usually a width of about twelve miles. The total depth immediately off this coast is over 100 fathoms, and the depth or thickness of the current itself was ascertained from measurements of the under-current taken as far down as 30 fathoms, at times when the surface speed varied, as usual, between one and two knots. It results from these measurements that we may consider the volume of this current to be represented by a body of water 12 miles in width, with a mean depth of 30 fathoms, and moving with an average speed of 0·68 knot per hour, throughout this depth.

Such a current has a volume forty-three times greater than that of the St. Lawrence River. The volume of the Cape Breton Current, also, is probably much the same. These outflows must therefore be replaced by a return movement at the entrance to the Lower St. Lawrence, somewhere in the Anticosti region; and also by a return flow from the Ocean into the Gulf area, as the discharge of the St. Lawrence furnishes less than 3 per cent. of the amount required in either case.

The current which usually makes inwards around Cape Ray on the east side of Cabot Strait may be sufficient to compensate for the outflowing water of the Cape Breton Current; although it is also possible that the outflow from the Gulf may be partly made up for by the difference of flow in the inward direction through Belle Isle Strait, which in some years may be considerable in the early spring. This inflow at Cape Ray is in continuation of the general westward tendency of the water along the south coast of Newfoundland. The quiescence of the deep water in Cabot Strait is also to be noted in this connection.

It may be well to remark, however, that although the outflowing water of the Cape Breton Current is much warmer in the summer season than the incoming Atlantic water, it is not so at all seasons of the year. While it is probable that the total result is on the side of loss of temperature to the Gulf area, it would require extended observations throughout the year to ascertain the amount of loss and the probable effect, in consequence, upon climate in the surrounding regions.

The Current in Belle Isle Strait, in relation to the Gulf area as a whole.—On account of the tidal character of the current in Belle Isle Strait it is clear that no great volume of water can enter the Gulf of St. Lawrence from that quarter.

During the summer season the current flows in the Strait with a speed which is nearly equal in each direction; and there is only a difference in favour of inward flow to the west, which on the whole does not probably amount to more than a moderate percentage. From the discussion of all the evidence secured, it is perhaps possible that in the early spring the preponderance of inward flow may be proportionally greater than at other seasons. But no reasons have been found for supposing that this water passes completely round the west coast of Newfoundland and finds its way out into the Atlantic through Cabot Strait, between Cape North and Cape Ray, in accordance with the theory which has been more or less accepted up to the present time. All the indications are against this theory, as they show that any general current across the extent of the Gulf must lie in an entirely different direction. The reasons for this conclusion are discussed in the Tidal Survey Reports, in which the tidal character of the flow in this Strait is described and the relations of the current to the tide, the temperature of the water and the drift of icebergs are fully explained. A diagram showing the flow of the current in the two directions as observed is also given.

General Circulation in the Gulf.—In reviewing the movements of the water, with a view to tracing the general circulation in the Gulf, it is the principle of the balance of flow which is the most evident. Wherever a current of a constant character occurs, there is a corresponding return current to make up for it. Thus in Cabot Strait, the outflowing water in the Cape Breton Current is balanced by the inflow at Cape Ray; the north-eastward current on the west coast of Newfoundland is balanced by the contrary direction of the movement on the opposite shore; and we have fairly good indications of a return flow to compensate for the Gaspé Current.

It is this balance of flow which points to the nature and direction of the circulation of water in the Gulf. If we begin to trace it from Cabot Strait, where the balance between the Gulf and the Ocean takes place, the inflow at Cape Ray appears to diffuse itself more or less widely over the central part of the Gulf, but it regains its strength further north on the west coast of Newfoundland, and makes a deep bend into the north-eastern angle of the Gulf, and returns westward along the north shore. On reaching Cape Whittle it still makes westward; and, whether as an actual set or by displacing water which comes more directly from Cape Ray, it appears to work around the eastern end of Anticosti, and so compensates for the outflow of the Gaspé Current, from the estuary of the St. Lawrence. This current, after rounding the Gaspé coast, makes south-eastward as a general set or drift across the Gulf to the western side of Cabot Strait; and its waters there leave the Gulf in the outflow of the Cape Breton Current.

It also appears that the whole of the balance or compensation in the Gulf currents takes place at the surface and in ordinary under-currents, which do not probably extend to a greater depth than 50 or 60 fathoms at the most. There is nothing, therefore, to show the necessity for any appreciable movement in the deep water from 60 to 80 fathoms downward, which lies in the deep channels of the Gulf. Where direct observations have been obtained, this deep water appears to lie quiescent, without any movement that can be detected.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. T. HUDSON BEARE, professor of mechanical engineering at University College, London, has been appointed to the Chair of Engineering in the University of Edinburgh, in succession to the late Prof. Armstrong.

MR. J. W. PULSFORD, late scholar of Sidney Sussex College, Cambridge, and second master of the Dorchester Grammar School, has been appointed a junior mathematical teacher in the Merchant Venturers' Technical College, Bristol.

SIR W. H. PREECE, K.C.B., F.R.S., will distribute the prizes and certificates to the students of the South-Western Polytechnic, Chelsea, on Saturday. The laboratories will be open for the exhibition of apparatus and experiment, and short lectures will be given in the course of the evening.

THE movement in favour of the establishment of a Liverpool University has received an impulse by the offer of Mr. A. L. Jones to contribute 5000*l.* towards that purpose. With the University College as a centre of activity, and the interest taken in educational matters in Liverpool, the movement ought soon to assume a practical form. At a special meeting of the council of University College, held on Tuesday, the following resolutions were adopted:—(1) That, while gratefully acknowledging the advantages which have accrued to University College, Liverpool, by its association with Victoria University, this council is of opinion that a University should be established in the city of Liverpool; that this council will welcome a scheme with this object upon an adequate basis; and that a committee be appointed to consider and report upon the whole question, with power to make inquiries and to communicate with other bodies. (2) That the committee consist of all the members of council, with power to associate with them any other persons whom they may think fit.

SIR WILLIAM HART DYKE presided at the annual meeting of the Association of Technical Institutions on Tuesday, and delivered an address, in the course of which he dealt with the necessity of a coordinated educational system, educational and industrial progress in America, the educational crisis produced by the decision as to the limitation of the powers of School Boards as regards higher grade and evening continuation schools, and the constitution of local authorities to be responsible for educational provision. Several resolutions were passed, among them being one approving the main provisions of the Secondary Education Bill, 1900, and hoping that the new Education Bill promised by the Government will prevent unnecessary and wasteful overlapping and competition between the educational work of School Boards and County Councils.

AT a meeting of Convocation of the University of London, held on Friday last, a resolution was carried to the effect:—"That the life composition fees paid by the graduates in lieu of annual subscriptions to Convocation, being the capital of the University, ought not to be retained by the Treasury; and that the Senate of the University be hereby requested to represent to the Chancellor of the Exchequer that the University is the equitable owner of the same." In proposing the resolution Prof. S. P. Thompson compared the London University with other Universities as regards the support given to it. He pointed out that the University of Berlin has 5140 students and that the State subvention is more than 105,000*l.* per annum, making about 21*l.* per student. The University of Rostock, with 514 students, has a State subvention of 17,000*l.*, or about 33*l.* per student, and the annual State subvention at Strassburg amounts to 44*l.* per student. The University of Edinburgh, with 2780 students, has a Parliamentary grant of 25,870*l.*, or about 9*l.* per student; and the University of St. Andrews, with 236 students, enjoys a grant of 10,800*l.*, or 45*l.* per student per annum.

TO all who are interested in the subject of education in country districts we recommend for serious consideration a small pamphlet which we have received from the Board of Education and which bears the title "Specimen Courses of Object Lessons on Common Things connected with Rural Life and Industries for all Classes in Rural Schools." It has long been recognised by educational authorities that there should be a differentiation between urban and rural education, and two years ago Sir John Gorst, in the course of a speech delivered at the Countess of Warwick's school near Dunmow, dwelt upon this necessity with his accustomed vigour of expression. Since that time the Agricultural Education Committee have been working most energetically to bring about this much-desired result, and the manifesto of the Board of Education may in some degree be looked upon as one of the practical issues of the voluntary labours of the gentlemen composing that Committee. Of course in all educational reforms in this country the usual difficulties of vested interests, inelasticity of teachers, hostility of those who fail to see the importance of nature knowledge, &c., have to be faced and, if possible, overcome. The schedules now issued should go a long way towards removing these difficulties, and it is satisfactory to learn from the introductory statement that the schemes submitted are actual examples of attempts now being made to adapt the teaching in rural schools to the requirements of country life. One paragraph, pointing out the connection of the new schemes with other studies, strikes us as being an admirable answer to those objectors who declare that the introduction of these rural subjects entails the subordination or suppression of other necessary subjects. It is shown most conclusively in this paragraph that no additional burden is imposed upon the teachers or pupils, but simply a "change in the contents of the lessons in the ordinary subjects." The Board recognise that the desired change can only be brought about gradually. It is not often that we find a Government Department actually in advance of the times, but in the present case we certainly must credit the Board of Education with having made a most important step in the right direction.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, April 2.—Dr. Albert Günther, F.R.S., vice-president, in the chair.—Mr. G. P. Mudge read a paper on the myology of the tongue of parrots, and added a tentative classification of this order of birds placed upon the structure of the tongue. This memoir was the outcome of an examination of the tongues of fifty-three parrots ranging over the whole order, the Cyclopsittacidæ excepted; and the conclusion arrived at by the author was that the parrots, by the structural characters of the tongue alone, might be arranged in three families, viz. Loriidæ, Nestoridæ and Psittacidæ.—A communication was read from Prof. W. Blaxland Benham on the larynx of a rorqual whale (*Balaenoptera rostrata*) and of a cachalot of the genus *Cogia*. The paper was based upon an examination of the larynxes of specimens of these cetaceans, which had been washed up on the coast of Dunedin, New Zealand, and in it the author showed how widely different this organ was in these representatives of the Mystacoceti and the Odontoceti.—A communication from Mr. F. F. Laidlaw contained an account of the lizards collected during the "Skeat Expedition" to the Malay Peninsula in 1899-1900. Twenty-seven species were enumerated in the paper, and notes were given on their geographical distribution and habits, special attention being directed to the curious habit of *Tachydromus sexlineatus* of running about on the top of the long buffalo-grass. One new species was described, under the name *Lygosoma floweri*.—Prof. D'Arcy W. Thompson, C.B., read a paper on the pterylosis of the giant humming-bird, *Patagona gigas*.

Entomological Society, April 3.—Mr. Charles G. Barrett, vice-president, in the chair.—The Rev. A. E. Eaton sent for exhibition, on behalf of Mr. F. M. Halford a ♀ sub-imago of a species of *Ephemeridae* of the genus Ephemera, received from Central Africa, without more precise indication of locality, this being the first time this genus has been noticed from Africa.—Mr. McLachlan remarked that Ephemera usually occurred in cold alpine or temperate regions, and that the Central African example probably inhabited the mountains at a considerable altitude.—Dr. Chapman exhibited cases of *Luffia ferchaultella* from Cannes, and a spider, which are found on the same rocks, the interest of the specimens being in the fact that the spider when at rest has almost precisely the same form and coloration as the cases of the moth.—Mr. W. L. Distant communicated a paper entitled "Enumeration of the Heteroptera (Rhynchota) collected by Leonardo Fea in Burma and its Vicinity."

MANCHESTER.

Literary and Philosophical Society, April 2.—Prof. Horace Lamb, F.R.S., president, in the chair.—Mr. W. E. Hoyle exhibited an old form of dial, bearing the name "Nathaniell Jeynes" and the date "1678," which had on one side a small circular rotating plate inscribed with the circumpolar constellations.—Mr. C. E. Stromeyer mentioned that on several occasions he had seen the sun's rays converging to a point directly opposite to the sun. In one case, when the sun was very low on the western horizon, some very marked rays, caused by a low bank of clouds, converged to a point above the eastern horizon.

—The president communicated some numerical illustrations of the diffraction of sound. These were intended to show the extreme facility with which sounds of relatively large wave-length can make their way round obstacles or through apertures. Thus, with a wave-length of 4 feet, a wire $\frac{1}{10}$ of an inch in diameter dissipates only the fraction $6{\cdot}6\times10^{-8}$ of the energy which falls upon it; a spherule of water $\frac{1}{1000}$ of an inch in diameter scatters only $1{\cdot}3\times10^{-16}$. Again, a perforated screen or grating may present hardly any obstacle to the transmission of sound, although the apertures occupy only a small proportion of the total area. Reference was made to the bearing of such results on the attempts made to improve the acoustic properties of buildings by hanging wires, and on current notions as to the possibility of the reflection of sound from clouds.

PARIS.

Academy of Sciences, April 9.—M. Fouqué in the chair.—On the scientific utility of an auxiliary international language, by M. H. Sebert. This language should be capable of being used for the ordinary intercourse of social life, for commercial purposes and for scientific reports; it should be easy of acquisition, and it ought not to be an existing language. Nor can a dead language be used, even if its grammar were simplified and its vocabulary enriched. The creation of a new artificial language alone permits the realisation of simplicity and the unity of method to be obtained by the union of elements borrowed from different living tongues.—On the services which the auxiliary international language of M. le Dr. Zamenhof, known under the name of *Esperanto*, can render to science, by M. Ch. Méray.—Generalisation of Trouton's law, by M. de Forcrand. In all chemical or physical phenomena the heat of solidification of any gas is proportional to its temperature of vaporisation under atmospheric pressure.—New method of distinguishing colouring matters, application to the indophenols, by MM. C. Camichel and P. Bayrac. The absorption of light by solutions of indophenols in alcohol, ether, carbon bisulphide and chloroform has been studied. Taking wave-lengths as abscissæ and coefficients of transmission as ordinates, curves of the form of the parabola were obtained with the convex side towards the axis of abscissæ; the branch of the curve corresponding to the red rises much more rapidly than that corresponding to the green or blue. To distinguish each of the compounds studied, the lowest point of the curve was determined—that is, the minimum transparency. This minimum is independent of the concentration for all the compounds of which the coefficient of absorption is proportional to the concentration, following Beer's law; it varies with the solvent in a manner different from that noticed by Kundt.—On the reaction of the amidobenzophenones and the aromatic amines in the presence of sulphuric acid, by M. Paul Lemoult. In the presence of sulphuric acid the paramidobenzophenones give with certain aromatic amines, to the exclusion of others, reaction products which are colouring matters; the only amines capable of this reaction are those which have at least two aromatic groups directly united with nitrogen; it is necessary, moreover, that one of these be a phenyl group, and that its para-position be free, the nitrogen being in 1.—The angle limiting the numeration of objects and the movements of the eyes, by MM. André Broca and D. Sulzer.—Is the resistance of Algerian sheep to foot-rot hereditary? by M. P. Pourquier.—On Koswite, a new pyroxenite from the Ural Mountains, by MM. L. Duparc and F. Pearce.—On the "blood rain" observed at Palermo in the night of the 9th to 10th March, 1901, by M. Stanislas Meunier. In a hundred parts of the powder were found, water, 5·20; organic matter, 3·17; sand, 59·14; carbonate of lime, 23·91; and (by difference) clay, 8·58.—On the oxidation of iron protosulphide, by M. Gay-Lancermin.

DIARY OF SOCIETIES.

THURSDAY, APRIL 18.

ROYAL INSTITUTION, at 3.—Naturalism in Italian Painting: Roger Fry.

SOCIETY OF ARTS (Indian Section), at 4.30.—Madras, the Southern Satrapy: J. D. Rees.

RÖNTGEN SOCIETY, at 8.—Meeting for Discussion. Subject: X-Ray Therapeutics: To be opened by Miss M. M. Sharpe.

CHEMICAL SOCIETY, at 8.—Researches on Moorland Waters. Part II. On the Origin of the Combined Chlorine: W. Ackroyd.—Robinin, Viola-quercitrin, and Osyritrin: A. G. Perkin.—Preparation of Orthodimethoxybenzoin, and a New Method of preparing Salicylaldehydemethylether: J. C. Irvine.—(1) Action of Alkyl Haloids on Aldoximes and Ketoximes, Part II. (2) The Supposed Existence of Two Isomeric Triethyloxamines: Wyndham R. Dunstan and E. Goulding.—(1) Nitrocamphene, Aminocamphene, and Hydroxycamphene; (2) Action of Hydroxylamine on the Anhydrides of Bromonitrocamphane: M. O. Forster.—The Influence of Cane Sugar on the Conductivities of Potassium Chloride and Potassium Hydroxide, with Evidence of Salt Formation in the Latter Case: C. J. Martin and O. Masson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Replies of Mr. H. Ravenshaw and Mr. S. F. Walker to the Discussion on their Papers read at the last Meeting.—Test-Room Methods of Alternate Current Measurements: A. Campbell.—Note on the Use of the Differential Galvanometer: C. W. S. Crawley.

FRIDAY, APRIL 19.

ROYAL INSTITUTION, at 9.—The Existence of Bodies Smaller than Atoms: Prof. J. J. Thomson, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Theory of Cast-Iron Beams: E. V. Clark.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Address by the President, W. H. Maw.

SATURDAY, APRIL 20.

ROYAL INSTITUTION, at 3.—Climate: its Causes and Effects: J. Y. Buchanan, F.R.S.

MONDAY, APRIL 22.

SOCIETY OF ARTS, at 8.—Alloys: Sir W. C. Roberts-Austen, K.C.B., F.R.S.

TUESDAY, APRIL 23.

ROYAL INSTITUTION, at 3.—Cellular Physiology, with Special Reference to the Enzymes and Ferments: Dr. A. Macfadyen.

ROYAL STATISTICAL SOCIETY, at 5.

WEDNESDAY, APRIL 24.

SOCIETY OF ARTS, at 8.—Patent Law Reform: Alexander Siemens.

GEOLOGICAL SOCIETY, at 8.—Notes on Two Well-Sections: Rev. R. Ashington Bullen.—(1) On the Geological and Physical Development of Antigua; (2) On the Geological and Physical Development of Guadeloupe; (3) On the Geological and Physical Development of Anguilla, St. Martin, St. Bartholomew, and Sombrero; (4) On the Geological and Physical Development of the St. Christopher Chain and Saba Banks: Prof. J. W. Spencer.

THURSDAY, APRIL 25.

ROYAL INSTITUTION, at 3.—Naturalism in Italian Painting: Roger Fry.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—"James Forrest" Lecture—On Chemistry in its Relations to Engineering: Prof. Frank Clowes.

FRIDAY, APRIL 26.

ROYAL INSTITUTION, at 9.—Colour in the Amphibia: Dr. Hans Gadow, F.R.S.

SOCIETY OF ARTS, at 8.—Polyphase Electric Working: Alfred C. Eborall.

PHYSICAL SOCIETY, at 5.—On the Thermodynamical Correction of the Gas Thermometer: Prof. Callendar, F.R.S.—On the Production of a Bright-line Spectrum by Anomalous Dispersion and its Application to the Flash-Spectrum: Prof. R. W. Wood.

SATURDAY, APRIL 27.

ROYAL INSTITUTION, at 3.—Climate: its Causes and its Effects: J. Y. Buchanan, F.R.S.

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